McGRAW-HILL MAGAZINE OF DESIGN RESEARCH AND DEVELOPMENT

OCTOBER 6, 1958 PRICE 50 CENTS

Product Engineering

R and D RESEARCH and DEVELOPMENT now issue

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PLAN '59

Modernize now for growth and profits

A SPECIAL REPORT FROM McGRAW-HILL TO AMERICA'S BUSINESS EXECUTIVES

As part of a broad McGraw-Hill program, Product Engineering presents two special reports. The first, "WHY Modernize," is in this issue, the second "HOW to Modernize, appears Oct. 13.

"The new look in BRECK shampoo packaging! Beautiful, lightweight, unbreakable, plastic jars, molded from

MARLEX*"

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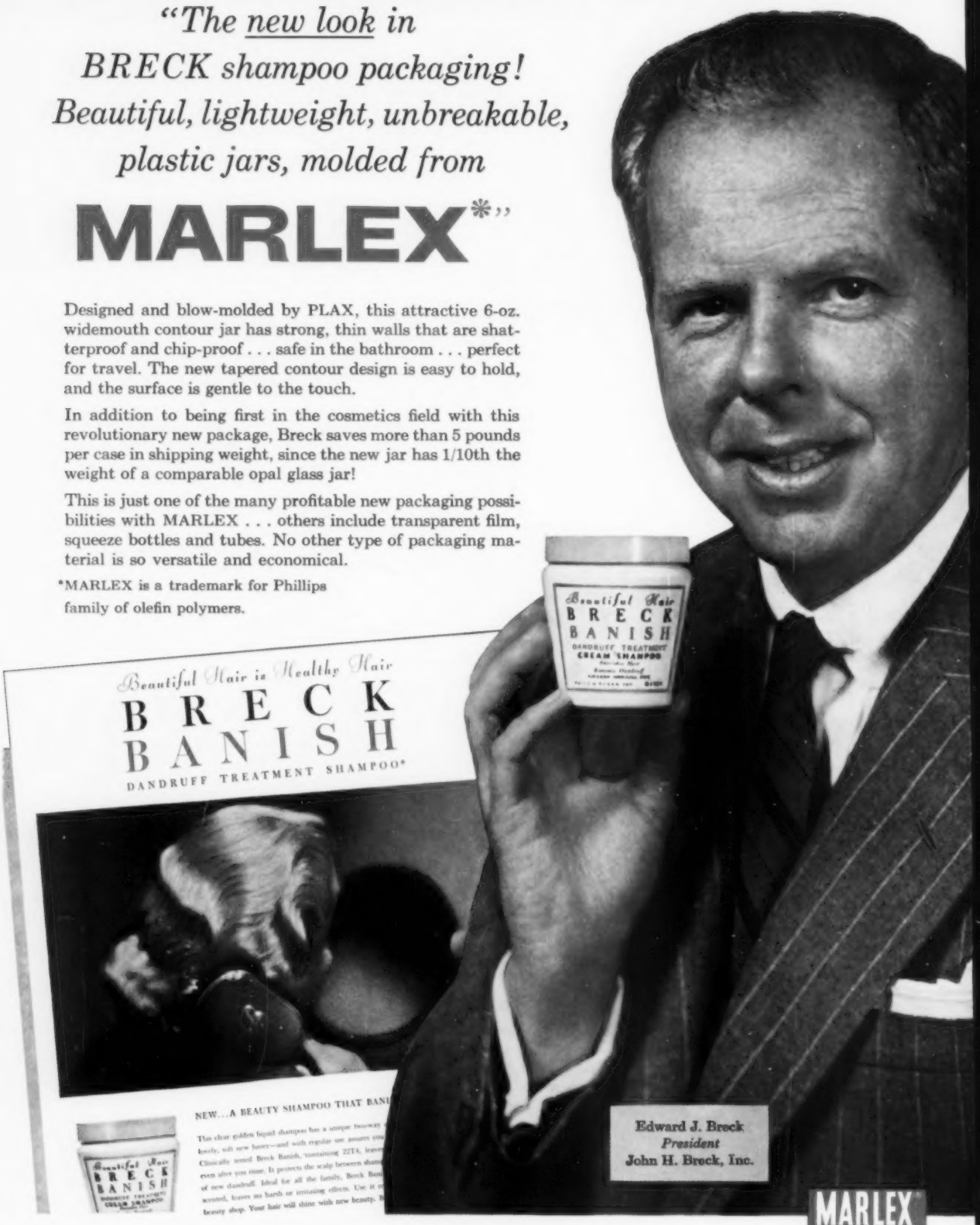

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Product Engineering
presents two special reports.

The first,
"WHY, MODERNIZE,"
appears in this issue.

The second,
"HOW to MODERNIZE,"
will be published October 13.

Read this roundup of the most advanced thinking on

MANAGEMENT • BUDGET
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RESEARCH • DEVELOPMENT
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MODEL SHOP

coming next week . . .

the DESIGN issue

for October 13

FEATURING

- **A motor bibliography**
  Articles in the broad field of motor selection from sub-fractional to 1000 hp and over.
- **Slip casting . . . the field broadens**
  This slurry method has made a start with powdered metal. Here's how it stacks up.
- **Finite differences to differentiate curves**
  A numerical approximation that's faster and more accurate than graphical methods.
- **Name plates for prototypes**
  Anodized aluminum sheet is photo-sensitized, exposed and later etched.
- **15 Special-purpose bearings**
  Linings, bearings and mounts for round, revolving shafts.
- **Finishes for stainless steel**
  Tables of electropolishing and other methods to make stainless look right for your application.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D Research and Development news issue

October 6, 1958 Vol. 29, No. 41

FEATURED:

DEPARTMENTS:

SIDELIGHTS 2

HORIZONS 21

SIGNIFICANT COMPONENTS 35

NEW LITERATURE 39

PUBLISHER'S POSTSCRIPT 40

FYI PERSONAL 41

WHY NOT R & D? 42

WHY MODERNIZE?
A special report showing why your research, design and development departments must modernize NOW.

RESEARCH AND DEVELOPMENT—how much should you spend? 23

Is your ENGINEERING LABORATORY still in the race? 26

Plan for efficiency with modern DRAFTING EQUIPMENT 28

COMPANY LIBRARIES stretch R & D funds 30

MODEL SHOP saves development time 32

FIELDS OF INTEREST:

MATERIALS:

Strong, ductile zinc foil to compete with copper, aluminum 5

Polaris may have materials problem in first stage 7

Two heat-resistant polystyrenes announced in England 8

Paper and cellulose under study at NBS 11

PROCESSES:

Irradiated gases are new material source 10

Cerium aids in making super alloys and better solder 11

ELECTRICAL:

Pulse counter to rates of 100,000/sec 5

Electronic refrigeration being evaluated by Navy 5

DESIGN:

Second engine for cars to power accessories 5

New optical elements based on spherical aberration 8

Controlled heat—a new gas-oxygen lab burner 10

TEST:

Voice-actuated equipment a step closer 8

Atom data here and coming from Geneva Conference 10

Impact resistance at 300F below zero 11

Automated railway tested in Russia 16

PERSONNEL:

Safety gets big investment from car-makers 15

Don't develop and license your own invention 15

GOVERNMENT:

New space agency takes over from NACA on Oct. 1 7

Air Force Falcon has ceramic nose cone 7

NSIA previews government procurement law 18

Product Engineering ..... SIDELIGHTS

Research and Development news issue

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PLAN '59

● **Company-wide editorial programs** are relatively rare in McGraw-Hill. The entire business and industrial community must be vitally interested in a subject to justify such coverage. But once started, the attention that can be brought to bear is truly awesome. Some 600 editors and writers have contributed to the current Modernization program by researching and analyzing, interviewing and surveying—spending well over 10,000 man-hours to produce roughly 900 magazine pages—the equivalent of 10 good-sized textbooks. Unlike textbooks, however, this wordage is fresh out of our typewriters, as meaty as a telegram, as important as your business heartbeat. Take a look at other current McGraw-Hill magazines as well as PRODUCT ENGINEERING, and cash in on all the effort. Here is an important source of broad savings for your company and your department.

● **Modernization** still has many obstacles to run. To quote from a recent letter, "We are in the midst of a modernization program where the latest in grinding machines are replacing older models, plus many other changes. Naturally the capacity of the new equipment is greater than that of the old. In a 40-day strike just ended the union made such statements as, '. . . automating employes out of their jobs.' You and I know the answer to that one but it's a difficult message to get across."

● **Subway placards** are our best key to what the man-in-the-street thinks about everything from sex to science. We're rarely startled, but the latest addition to our collection really stopped us cold. The product advertised is a pain-relieving pill, the picture is of a man's head, evidently in agony as illustrated by a red, wavy line that starts at the head and pulsates out to the edges of the drawing. At a Greenwich Village station, an analytical passenger carefully lettered under the wavy line, "Fourier series:

$$y = 11 \sin \pi x + 5 \sin 2\pi x + \sin 3\pi x + \ldots +$$
$$4 \cos \pi x + 3 \cos 2\pi x + 2 \cos 3\pi x + \ldots"$$

ABP OCTOBER 6, 1958 **Product Engineering** *A McGRAW-HILL PUBLICATION* Vol. 29, No. 41

PRODUCT ENGINEERING is published weekly,—with an additional Design Digest Issue in Mid-September, by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. PUBLICATION OFFICE, 99-129 North Broadway, Albany 1, N. Y. See panel below for directions regarding subscription of change in address.

EXECUTIVE, EDITORIAL, CIRCULATION and ADVERTISING OFFICES: 330 W. 42nd St., New York 36, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice-President; L. Keith Goodrich, Vice-President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Joseph H. Allen, Vice-President and Director of Advertising Sales; A. R. Venezian, Vice-President and Circulation Coordinator.

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United States subscription rates for individuals in the field of the publication, $5.00 per year, single copies, 50 cents; Canadian subscription $7 per year; foreign $25 per year, payable in advance. Second-class postage paid at Albany, N. Y. U.S.A.

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PRODUCT ENGINEERING articles are indexed in both the **Industrial Arts Index** and the **Engineering Index.** PRODUCT ENGINEERING publishes its own semiannual index including the Design Digest Issue. Copies are obtainable on request to the Editor.

SUBSCRIPTIONS: Send subscription correspondence and change of address to Fulfillment Manager, PRODUCT ENGINEERING, 330 W. 42nd St., New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address giving old as well as new address, and including postal zone number if any. If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one to two issues in advance, please allow one month for change of address to become effective.

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CYANAMID

PLASTICS NEWSFRONT

Midget Adding Machine New Step in Miniaturization

This telephone-size, 7½-pound adding machine, the *Add-Mate*, is Underwood Corporation's newest bid to reduce size and weight of business machines. Easily portable, it can be slipped into a desk drawer or under a counter when not needed. Contributing to its compactness and lightness is the attractive, two-toned housing of CYMAC SUPER* 201 methyl-styrene-acrylonitrile copolymer plastic.

THE COLORFUL TWO-PIECE HOUSING is molded of CYMAC SUPER. Shown above, respectively, are the complete unit, the unit minus the top section, and the inner sides of the top and bottom sections. CYMAC SUPER was selected because of its toughness, surface hardness, and resistance to heat, staining and denting. It is unaffected by the diester permanent lubricant applied to the mechanical assembly prior to encasement in the housing. The transparent, serrated tear-plate, also CYMAC SUPER, and the housing are injection-molded for Underwood by Nopco Plastics, Inc., Erie, Pa. *Trademark

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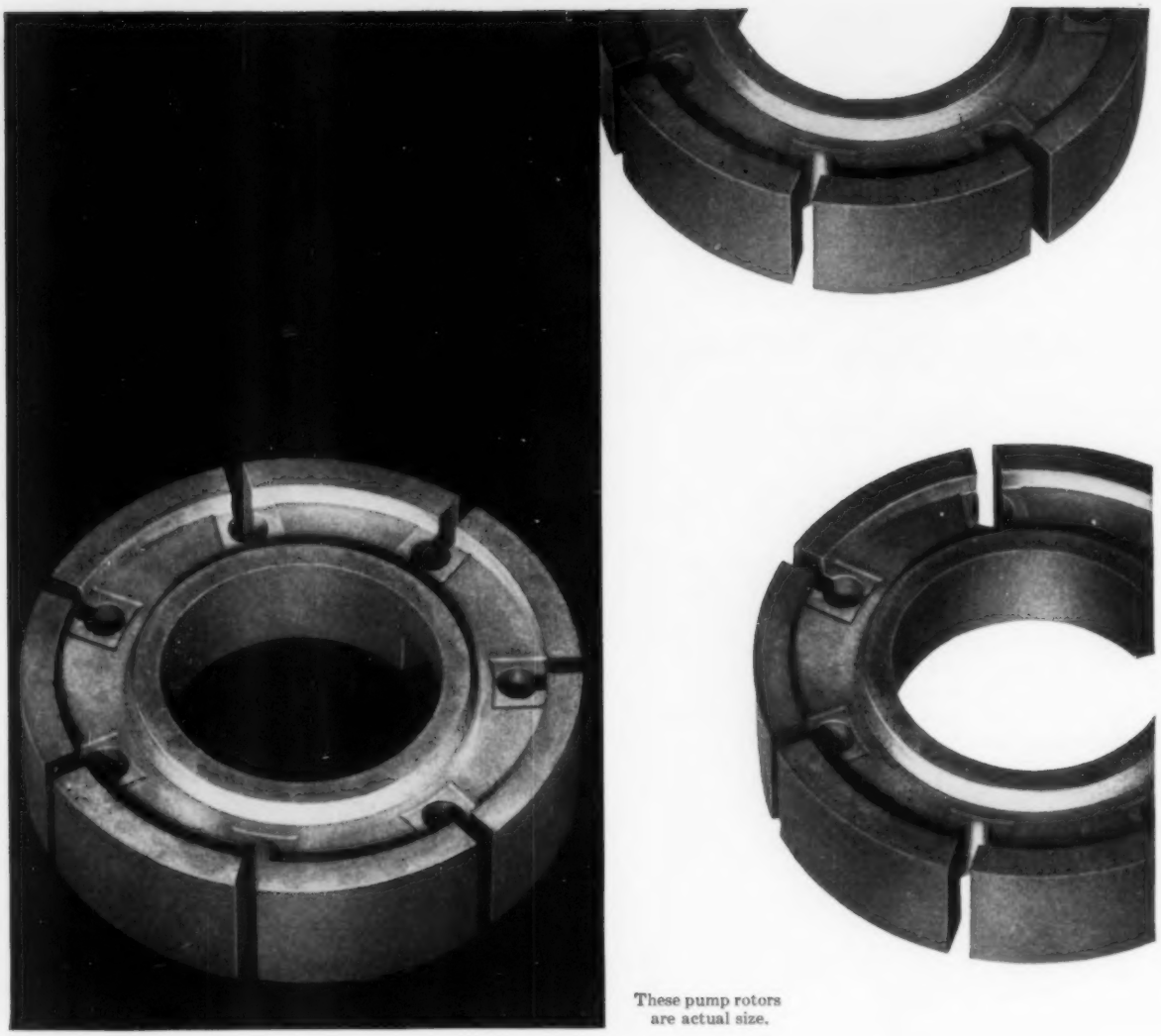


These pump rotors are actual size.

Just how *strong* are sintered metal parts?

Sintered metal parts by Moraine Products prove their strength and stamina every day on a wide variety of jobs. Take the automatic transmission pump rotors that are shown above. Millions of them perform efficiently and dependably *billions* of times during the life of the transmissions in which they are used. Rugged long-lasting sintered metal parts by Moraine Products are the modern economical answer for an ever-increasing number of applications.

Moraine Products also produces: Moraine Power Brakes • Delco hydraulic brake fluids, brake assemblies, master cylinders, wheel cylinders, and parts • Moraine friction materials • Moraine-400 and M-100 automotive engine bearings • self-lubricating bearings and porous metal filters • rolled bronze and bi-metal bushings.

Moraine Products
Division of General Motors, Dayton, Ohio

American ...

DEVELOPMENTS TO WATCH...

Second engine for cars? . . .

. . . It's beginning to look that way. Recognizing the power penalty that today's multiplicity of accessories is beginning to impose, auto makers are seriously thinking in terms of a small, constant-speed auxiliary engine that will take over the extra load. GM has put one in its experimental Firebird III.

The Firebird unit is a 10-hp, 2-cyl, 53-lb all-aluminum unit, specifically designed as a companion to the Firebird's turbine prime mover. It's set up to power the hydraulic system and also to drive a 110-v generator that provides 60-cycle electric power.

Other companies are thinking of 5-hp gasoline engines that might be mounted in the rear compartment and would relieve the standard gasoline engine of at least part of its load. Look for more news of this as the 1960 models are readied for introduction.

Strong, ductile zinc foil . . .

. . . that is easy to solder and boasts high chemical purity, is promised by American Smelting and Refining as a result of a new electrolytic production process, now in pilot plant at its Central Research Laboratory. Foil sheets up to 26 in. wide and 0.005 to 0.001 in. thick are now being turned out in developmental quantities, and a larger-scale pilot plant will soon be built.

When the process reaches commercial application, Asarco says, it will give foil that can sell at a lower price than copper and "will probably be cheaper than comparable aluminum foil."

For counting pulses at rates to 100,000/sec . . .

. . . or more, in computers, controllers, and scaling devices, General Time Corp is readying a group of devices which, it says, represent a "major advance in simplification of electronic circuitry."

These new "Incremag" units are built up from a series of basic magnetic-core stages and pulse-formers to achieve the desired output. In one model, for instance, 3 basic stages and a pulse-former provide the equivalent of 4 outputs (1 to 1, 1 to 10, 1 to 100 and 1 to 1000) in a unit less than 2 in. long.

Each basic stage, weighing less than ½ oz, and having a volume less than 0.4 cu in., can have any desired count up to a maximum of 16 per unit, will accept either random or uniformly spaced pulses, and will retain prior counts even if power fails. Operating temperature range is minus 65 to 130F.

First models of electronic refrigerator . . .

. . . developed by Nortronics Div, Northrop Aircraft (*PE—Sept 22, p 5*) and now evaluated by the Navy. These are thermoelectric devices, taking advantage of the fact that, when an electric current is passed across the junction of two dissimilar metals, one junction becomes hot and the other cold. The cold junction is then used to draw heat from the device being "refrigerated."

The devices now being made at Northrop are very tiny—designed to cool small components not much more than an inch or two in length. But company engineers are continuing their research on the system, believe high-capacity devices can be developed for consumer as well as military use. —ARG

Temperature drops 50 degrees when current is applied to dissimilar metal junctions of "electronic refrigerator." Evacuated envelope of device pictured here incorporates thermoelectric element and also the infrared sensor it cools. Fins at base aid heat dissipation.

In parallel shaft drives . . . look for

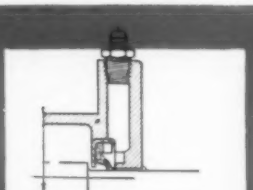
resistance to shock and overloading

You'll find it . . . and these "plus" performance features . . . when you specify LINK-BELT

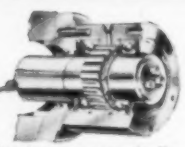
Under the shocks and overloads that are often encountered by parallel shaft gear drives, rugged housing construction is vital if shaft alignment is to be maintained. That's why Link-Belt adds special reinforcement at points of greatest stress . . . has developed this design expressly for endurance in heavy-duty service.

Write for your copy of Book 2619 on this broad line with ratios to more than 300:1. Or get first-hand information from your nearest Link-Belt office.

Automatic splash lubrication reliably supplies oil to all gears and bearings.



Grease-lubricated seals on all input and output shafts prevent entrance of dirt, water.



Backstop automatically prevents reverse rotation of output shaft due to power stoppage or other causes.

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American ...Washington

DEVELOPMENTS TO WATCH...

A ceramic nose . . .

is being used by the Air Force's new Falcon guided air rocket. The missile, the fourth in a series of Falcons, was developed for the Air Force by the Hughes Aircraft Co.

The new missile is slated to go into service soon as the main payload of the air defense command's all-weather jet interceptors. It is pegged as giving a "longer, higher and deadlier reach than that of any other air-to-air missile."

In spite of rumors to the contrary, Washington officials say that the Navy's Vanguard program will remain as originally planned. This calls for five more shoots at about six-week intervals. It means the program will run into next spring before it is completed. Then, speculation has it that the new National Aeronautics and Space Agency will take over the project, but keep the present Vanguard missile and technical team. Success of succeeding shoots may well determine how much of the present Vanguard project is retained, however.

Although only one of its satellites has been put into orbit in seven tries, rocket experts still claim the Vanguard is the most sophisticated missile the US possesses.

The new space agency . . .

is slated to take over the functions of the National Advisory Committee for Aeronautics on Oct 1. Congress gave it until Oct 29 to make the change. Then, its director, Dr. T. Keith Glennan, formerly president of Case Institute, is expected to reveal in detail what the new agency's role will be in some of the current space programs such as moonshoots, man-in-space and others.

Underground nuclear explosions . . .

for peaceful purposes are caught in a diplomatic squeeze play. At stake for the US is Project Plowshare, a year-old Atomic Energy Commission program to develop industrial uses for underground explosions of atomic devices.

It is thought that the bomb's energy can be harnessed to break up mineral formations, make oil flow, produce steam for electric power generation, and mass produce radioactive isotopes far more cheaply than under present methods.

The Atomic Energy Commission has scheduled an experimental shot in New Mexico next summer to explore the latter two applications. And, government and industry teamwork is expected to lead to more such tests.

But, the Russians are raising a fuss. They fear that Project Plowshare is a phony, a cover-up for continued A-bomb testing. They want to ban all nuclear tests, "peaceful" or not. President Eisenhower and the Atomic Energy Commission want to exempt Plowshare from any testing ban.

The issue comes to a head Oct 31, when east-west negotiators meet in Geneva in quest of an agreement to stop bomb tests. So AEC is stalling off work on Plowshare until the air is cleared.

There is a possibility that US negotiators will sacrifice Plowshare if they can win a larger victory in the talks with the Soviets.

AEC Commissioner Willard Libby says abandonment of the project would be tragic, however. Reason is Libby says, it would be hard to ever recreate the enthusiasm which exists now in industry for the project. But, it is a controversial matter. Some experts doubt that the whole idea is feasible. Their thinking would make a US concession at Geneva less stinging —if it is made.

The Navy's Polaris . . .

1,500-mile solid-fueled missile, may have a materials problem in the first of its two stages, although the recent failure of a test vehicle shoot was laid to a failure of the vehicle "to program as planned."

Before the Department of Defense had issued an official news release on the failure, however, a Pentagon materials spokesman commented, "I'm not surprised, we have known that there is a materials problem with that missile for some time. In the first stage of the missile," he said, "the steel case material is being put under much higher bi-axial stress than it should be, causing a brittle reaction." (See PE–Oct 27, "Seven Closer Looks at Mechanical Properties.")

"A change in heat treatment of the metal or a change in the welding procedure will likely be necessary," he said.

World-wide ...

DEVELOPMENTS TO WATCH...

New optical elements . . .

. . . designed in Australia for use in machine alignment devices, projectors, microscopes, and the like, take advantage of spherical aberration, rather than trying to minimize it.

These are axicons, which produce a series of images spread out in space, rather than a single image focused at one point. It is this spread-out line of images that makes axicons useful as alignment devices—over distances as great as 75 or 100 feet.

The novel feature of the Australian axicons is their shape. Those produced commercially in the US are flat on one side, conical on the other. The Australian elements have spherical surfaces — far easier to produce. They were developed by W. H. Steel of the Division of Physics, Commonwealth Scientific and Industrial Research Organization, Sydney, and have already been used in an autocollimator for making right-angle settings.

Two heat-resistant polystyrene plastics . . .

. . . one a thermosetting material; the other a thermoplastic like its parent compound, are announced by Lucent Products Ltd, Surrey, England.

The thermosetting material will stand temperatures to and sometimes above 270 F, can be shaped by heat, and is being produced in sheets, rods, and blocks. Technically, it's a cast styrene-divinylbenzene copolymer.

The thermoplastic is also a copolymer, but this is a moldable compound. It was specifically developed as a high-temperature dielectric, but is also suggested for use in light filters and parts which must withstand steam sterilization. It's said to have a softening point "not less than 270 F" and to be suitable for continuous use at temperatures to 250 F. Dielectric properties are similar to electrical-grade polystyrene at all frequencies, though the loss tangent decreases with increasing temperature.

In mechanical properties and machinability, both new materials are said to be similar to regular-grade polystyrene, and they show excellent resistance to solvents.

Voice-actuated equipment comes . . .

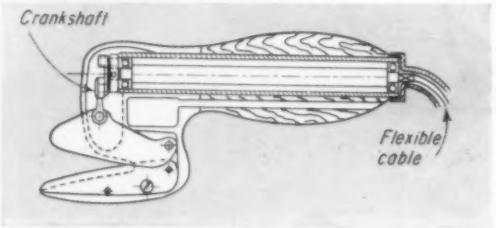
. . . a step closer with the development of a "Parametric Artificial Talker" by Britain's Ministry of Supply. This is a device designed to produce, electronically, "all the sounds normally used in speaking," and string them together to produce recognizable words. Its purpose: to study speech and the sounds required for intelligible communication.

Heart of the device is a "sound synthesizer" containing an electron tube oscillator, a random-noise generator, and several electrical resonators, controlled by electrical signals. Signals may be fed to the controller by computer-type input devices.

While the primary aim of Ministry of Supply researchers is to improve long-distance telephone operations, the information gained should have direct value in designing voice-actuated equipment, which also requires a reduction in the number of discrete sounds needed for communication.

One motor can take the place of two or more . . .

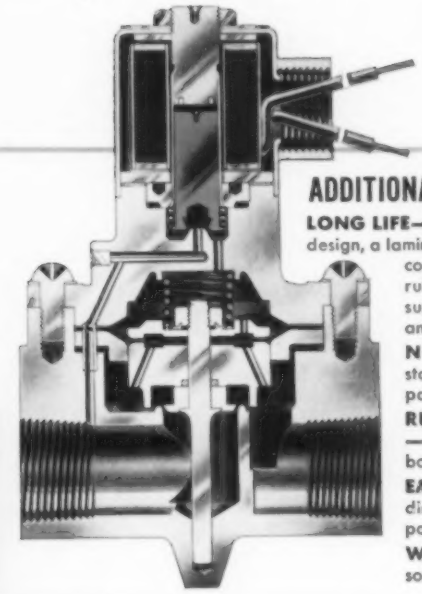
. . . if a Bowden flexible linkage is substituted for the standard mechanical linkage in devices like this electric scissors, Czech engineers report. As the diagram indicates, they've redesigned the device so that the motor is kept separate from the cutting head. A small crankshaft housed in the handle is driven by a flexible cable and operates the moving blade with this arrangement, the Czech engineers point out, several pairs of scissors can be operated by a single motor. —ARG



New scissors design, featuring simplified drive, is lighter in weight, permits operation of several units by one motor.

New low-cost, high-flow, 2-way valves with . . .

DEPENDABLE SKINNER QUALITY



ADDITIONAL FEATURES

LONG LIFE—unique diaphragm design, a laminate of nylon fabric coated with Buna N rubber, completely supported in open and closed positions.

NO RUSTING—stainless steel internal parts.

RUGGED DESIGN—forged naval brass body.

EASY TO MOUNT—direct to line in any position.

WILL NOT LEAK—soft, synthetic inserts.

L SERIES

These L Series valves with ¾″ and 1″ diameter orifices complete an *all new* line of 2-way valves previously introduced in January in the ⅜″ and ½″ sizes.

Manufactured to the highest engineering standards, these pilot-operated, high-flow industrial valves are a welcome addition to the famous Skinner solenoid valve line. They are smaller and more compact than the M2 Series they replace and feature a unique diaphragm design. They are also considerably lower in cost. The ¾″ size, for example, will cost you 51% less.

These larger L Series models – ¾″ and 1″ – will be available in standard and Explosion-proof construction, normally open or normally closed. They operate on a pressure differential of 5 to 150 psi and will control such common media as air, oil and water.

For complete information, please contact our Representative or Distributor near you . . . you'll find him listed in the yellow pages or write us at the address below, Department 450

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THE CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION
NEW BRITAIN CONNECTICUT
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What's happening in SCIENCE

Atom data: here and coming

The Second Conference on Peaceful Uses of Atomic Energy produced no great surprises. But it did bring forth a wealth of data on materials, energy sources, and research techniques that will prove valuable for years to come.

The problem is, getting data before they are too old. The more-than-2000 papers represent a tremendous editing and publishing job, and it is not expected that the official compendium will be available before June of next year. Individual papers, though, may be available sooner, from several sources:

First, many of the US companies whose representatives prepared papers for the conference are making these papers available in leaflet form. Consolidated Edison has one on its nuclear power plant; Allis-Chalmers on the recirculation boiling-water reactor it is developing.

Second, the US Atomic Energy Commission plans to publish the US papers. No publication date has been set, but they should be ready in advance of the complete UN set.

Third, Pergamon Press is preparing to publish about 400 of the "most important papers" in a set of 12 volumes. These will be available in the US at prices ranging from about $12 to $20 a volume "some time early next year."

(Note. The September issue of our sister publication, *Nucleonics*, devoted entirely to the conference, provides an excellent over-all review.)

New route to new materials?

Much has been said about the possibilities of turning liquids into solids and changing the properties of solids by atomic radiation. But AEC points to almost nothing done in the past on radiation treatment of gases as a possible way to create new materials or speed production of older ones.

Now, researchers at several laboratories are out to remedy that omission.

NYU scientists have been studying polymerization of such gases as acetylene by means of atomic radiation.

Detergents have been produced by reacting sulfur dioxide and oxygen with hydrocarbons in a gamma radiation field.

Nitric acid is being made at Oak Ridge by radiation-induced fixation of nitrogen from air.

While the primary interest of these researchers lies in the mechanisms of gas irradiation, many of these processes do seem to have commercial possibilities; and work is now underway to evaluate their economic prospects and uncover other useful reactions.

briefs . . .

Newest thermonuclear machine at U of California Radiation Laboratory is the Astron (*PE*—Sept 22, p 2). Like the U of C's earlier "mirror machine" (*PE*—*June* 16, p 10) and other thermonuclear devices, it's designed to use a rotating, helical beam of electrons to create a magnetic field and trap superheated gases, then hold them while atomic particles fuse.

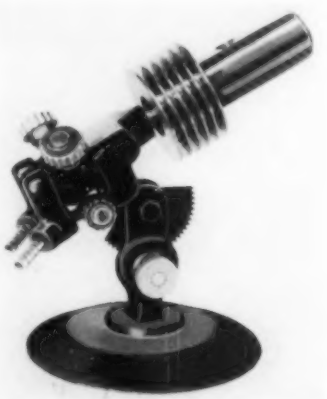
Hot problem for space-ship designers is how to keep space-travelers cool. But recent data indicate a little more leeway than originally estimated. Summarizing recent research, Dr. H. F. Carnes of Parke-Davis says that, if lightly clothed and not too active, a man can tolerate temperatures as high as 240 F for as long as 20 min.; and close to 200 F for 40 min. He won't be at top efficiency at either point, though. Even at temperatures only a little above the usual range, experimental high-flyers report listlessness and inability to concentrate.

Super-snoopers – ultrahighpowered electron microscopes, unveiled at last month's International Conference on Electron Microscopy in Berlin, included two from opposite sides of the world: one from Shimazu Mfg of Japan; the other from Philips of Eindhoven, Holland. Both claim resolving power in the millimicron range, have special features to prevent heat damage and distortion of materials.

Microfine quartz tubing can now be had from Monsanto Chemical Co in experimental quantities. Originally developed for AEC use in microbalances, the tubing is finding its first "industrial" application in Bell Labs' process for separating helium by controlled diffusion. Current price is about 10¢ a ft (the tubing runs about 40 miles to the lb); but should come down as applications develop. –ARG

Controlled heat for the lab

Innovations in gas-oxygen burners are few and far between. This laboratory mainstay has been "standard" for so long, hardly anyone thinks of making changes in it. Proof, though, that even the oldest dog can be taught new tricks is this model, just being introduced by Bethlehem Apparatus Co, Hellertown, Penna. It features a knob-actuated self-locking gear and friction level for more accurate height adjustment, and dual rather than quadruple fuel inlets; works on low- or high-pressure natural gas, butane, propane, or hydrogen with oxygen; can be used to heat treat metal parts as well as for the usual glass-working operations. It's 9 in. high, weighs 4½ lb; costs $125.



New heat source is said to provide an unusually hot flame, has two burners, separately controlled.

What's happening in MATERIALS

Un-rare earth helps steel and solder

Cerium, the "rare earth" metal that is anything but rare (you're probably carrying it around in your pocket in the form of lighter flints), is slated for even wider use as an additive—for steels and solders—that promises improved properties all along the line.

In steel, says the Bureau of Mines, cerium metal "may help science develop superalloys" better able to withstand the high temperatures encountered in rockets, missiles and other devices of the space age. High-purity cerium, produced in pound quantities for the first time by the Bureau of Mines laboratories at Reno, is a remarkably efficient "getter," able to remove impurities almost completely from other metals, thus making it possible to produce them in purer, stronger form.

Adding cerium to solders and other low-melting alloys is not new but recent research sponsored by the Tin Research Institute provides more information on when and how it should be used.

Says TRI: Addition of 0.05 to 0.10% of cerium to 70 Sn–30 Pb soklers produced an improvement of about 50% in the number of cycles that the joints would withstand. The percentages mentioned seem the most beneficial. Larger amounts apparently did not improve performance very much, and cerium did not seem as effective in solders with lower tin content as it was in the 70–30 alloy.

Engineering paper for product use

Important engineering data on paper and other cellulosic materials for electrical insulation, product cushioning, and other engineering applications may come from basic studies now underway at the Bureau of Standards. One is aimed at uncovering causes and cures for cellulose fiber degradation; another at improving dimensional stability of paper.

As NBS researchers point out, cellulose is chemically complex. Technically, they define it as a "partially crystalline mass of long, chain-like molecules composed of up to 10,000 units of glucose joined together by oxygen atoms." On this chain, there are a number of side-groups—aldehydes, carbonyls, hydroxyls, and the like—any one of which, they say, may be decomposed by ultraviolet light. The result is not only degradation of the fiber, but also formation of compounds which may be harmful to the materials with which the paper is in contact.

Already, considerable information has been obtained on photochemical evolution of hydrogen, and much more may be expected.

The problem of providing stability in paper is also complex, G. L. McLeod of NBS points out. At least four methods are now under test—use of synthetic fiber-cellulose fiber blends, modification of paper pulp by chemical treatment, addition of synthetic resins to pulp, and lamination of paper to dimensionally stable film.

(Note: A full-scale report on new types of paper being developed to solve engineering problems, is now in preparation, will be presented in a forthcoming issue.)

Materials at 300 below

A wealth of information on the behavior of materials at low temperature is coming from contractors in the missile and rocket program. Latest to report is The Martin Co.–on tests of the impact sensitivity of organic materials exposed to liquid oxygen.

At LOX temperatures (minus 297 F), many materials become so hard and brittle, they break almost at a touch; others detonate on impact. Yet a surprisingly large number were found to be acceptable on the basis of this impact-sensitivity test: An impact energy of 70 ft-lb was delivered to a 0.05-in.-thick sample immersed in liquid oxygen. Materials were considered acceptable if they showed no detonation in 20 impacts; or not more than one in 40.

Among those accepted: fluorocarbon plastics and several fluorocarbon oils and greases, ceramics impregnated with fluorocarbons, polyethylene sheeting and potting compounds, more than a dozen types of high-temperature wire insulations, asbestos-filled phenolic molding compounds, and cellulose-filled melamines.

Generally not considered suitable are: most other thermosetting and thermoplastic resins, most synthetic elastomers, cellulose-based paper laminates, petroleum-based oils and greases.

briefs . . .

Two new cellulosic fibers announced by Courtaulds (Alabama), Inc, are said to offer advantages that will "greatly increase the range" of this group of materials.

Both are said to have higher wet initial tensile modulus than viscose rayon and to be considerably more resistant to alkalis. One, Topel, resembles cotton in its water absorption and medium-tenacity rayon in its dry strength. The other, Corval, is said to show lower water absorption than cotton, and higher wet strength than rayon.

No dust-gathering on new polystyrene resins, Monsanto Chemical is determined. Already marketing a "low static" regular polystyrene (*PE*—Sept 22, p 42), it now has impact grades on a test basis, will soon introduce them commercially. These "Lo-Stat" materials are said to be so formulated that surface charges will neutralize each other, thus eliminating the electrostatic fields which make dust cling in unsightly patterns. Expected applications: radio and air-conditioner grilles, instrument-operating knobs, and the like.

Ductile chromium wire in experimental quantities is to be made available by the Bureau of Mines for developmental work. This is ultrahigh-purity material, prepared by several different methods and part of the Bureau's long-term research program aimed at finding out how to overcome the limitations and take advantage of the many desirable qualities of this metal as a structural material. (For an outline of problems and properties, see *PE*—Mar 17, p 66.) –ARG

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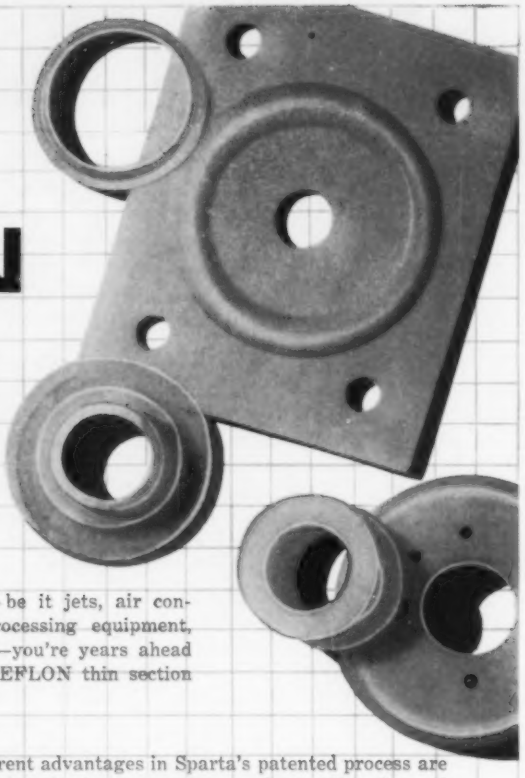

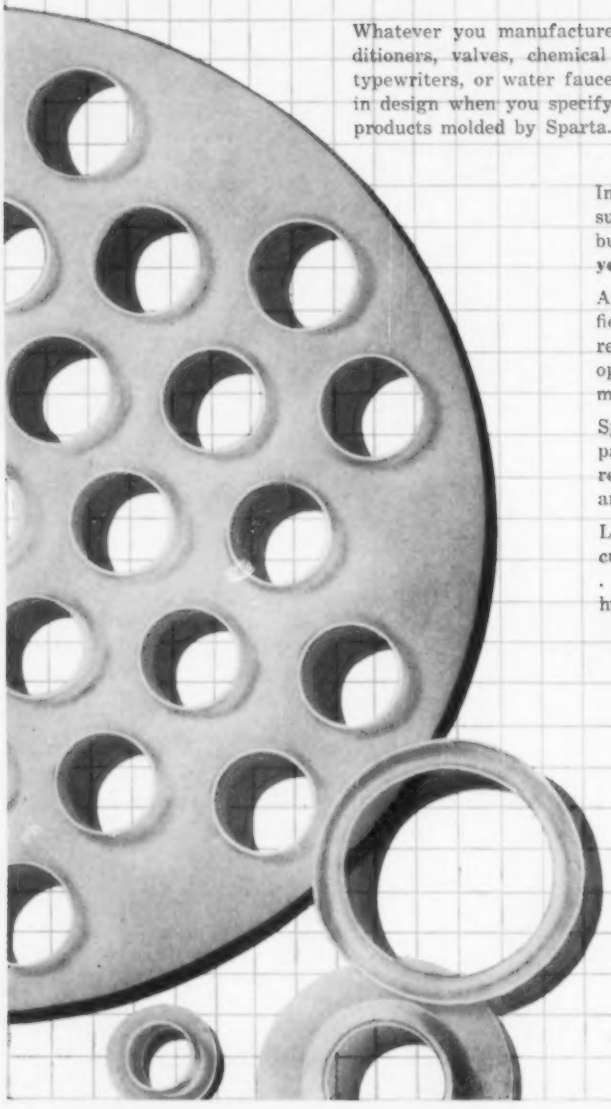

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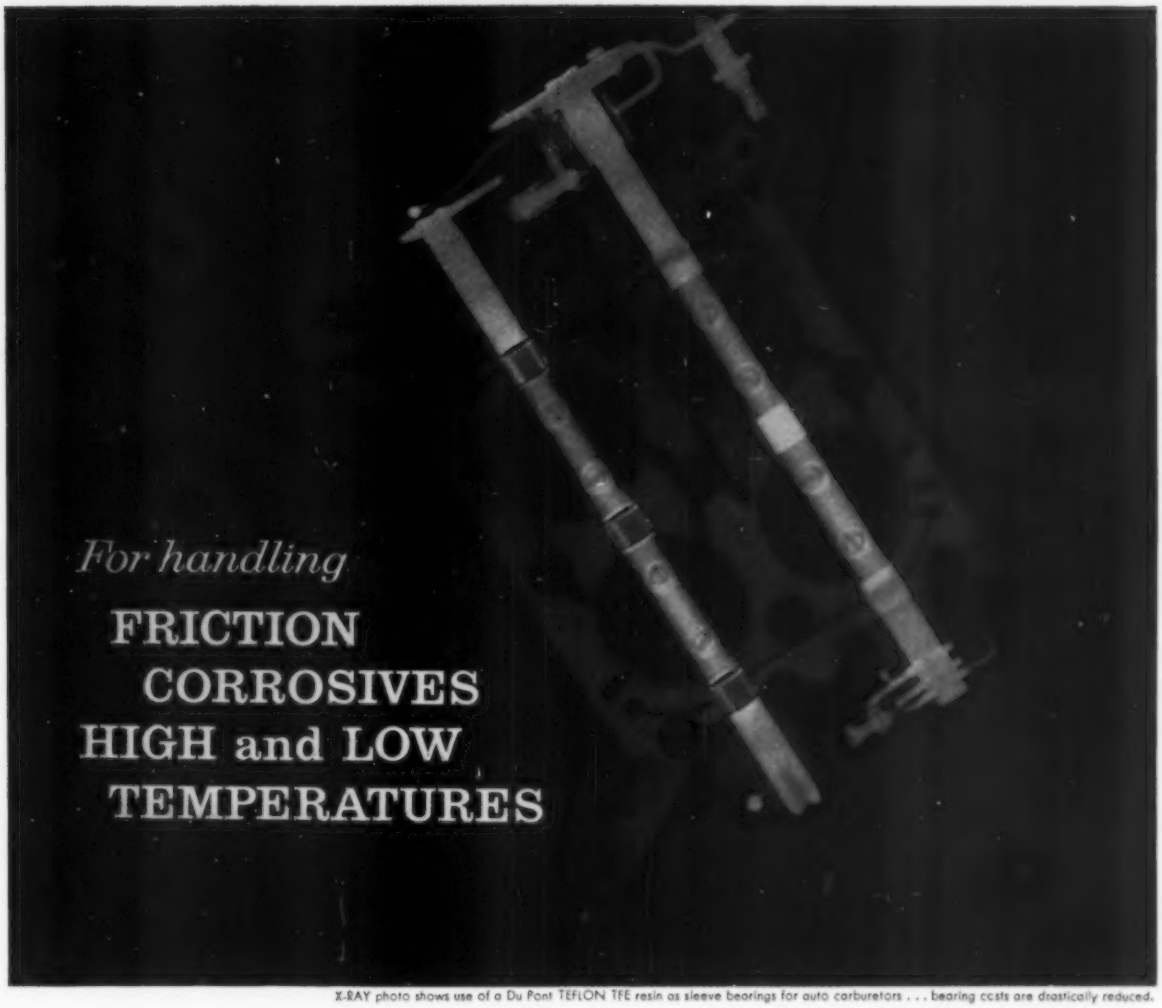

X-RAY photo shows use of a Du Pont TEFLON TFE resin as sleeve bearings for auto carburetors . . . bearing costs are drastically reduced.

Here's why bearings of TFE-fluorocarbon resins may be your solution

Bearings of TFE-fluorocarbon resins are "self-lubricating". Even the best lubricants used on metal rarely provide a coefficient of friction as low as 0.04, which is readily attained with TFE resins at low velocities. Moreover, TFE resins are among the most chemically inert materials known to science. They are rated for continuous use at temperatures from **–450°F. to 500°F.**

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• A heavy duty TFE resin construction replaced a super-alloy in rod-ends of aircraft controls. Lined sockets withstand operating loads as high as 60,000 psi without lubrication. Break-away and running friction are less than half that of a greased bearing.

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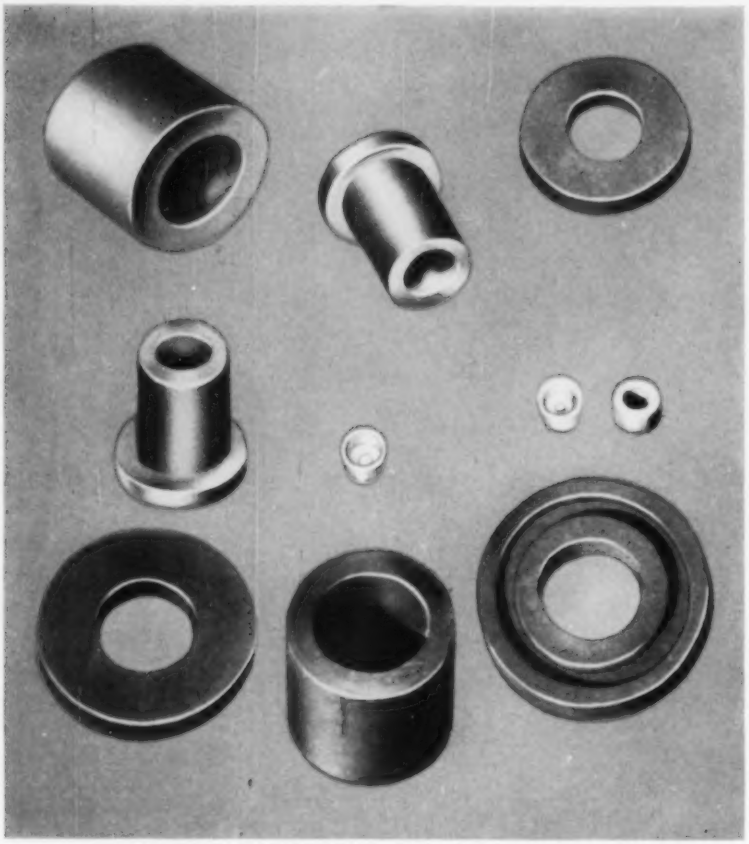

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Chemical & Power Products offers complete Filled Teflon Bearing services including:

❶ Chempro finished bearings, machined with correct interferences, tolerances and complete installation instructions.

❷ Chempro finished bearings, pressed into stainless steel, bronze or carbon steel housings, ready for installation.

❸ Chempro molded tubes of Filled Teflon Bearing Materials for machining finished bearings in the customer's own shop. Sufficient material will be available for finish machining. Complete machining instructions will be furnished, as well as interferences, tolerances and clearances of finished bearing, and accepted methods of retaining the bearings in the housing.

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STYLE	MATERIAL
FM-2	Glass-Filled Teflon
FM-3	Carbon-Filled Teflon
FM-4	Glass and Carbon-Filled Teflon
FM-5	Ceramic-Filled Teflon
FM-8	Graphite- and Zircon-Filled Teflon
FM-9	Molybdenum Disulfide and Glass-Filled Teflon
FM-10	Mica- and Glass-Filled Teflon

(Samples of these materials are available upon request.)

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Carmakers Spend $5-$6 Million Annually to Make Cars Safer

SAN FRANCISCO—American car makers each year spend between $5 and $6 million for safety-oriented research programs, according to Andrew A. Kucher, vice president of engineering and research for Ford Motor Co., who spoke at the 26th annual conference of the American Association of Motor Vehicle Administrators.

One company, he said, estimates that one-third of its annual safety research budget of $1 million is devoted to the problem of safely packaging passengers. The second third goes for safety control of vehicle components and the final third for such projects as lighting and development of general safety equipment.

Most automobile companies spend close to $250,000 annually for brake development programs. Studies of vehicle controls and stability vary from $150,000 to $350,000. Visibility studies as well as lighting projects are in the $50,000-a-year range. Studies of structural and crash-impact strength are most expensive, Kucher said.

He cited six areas: (1) efforts to improve driver awareness, (2) efforts to improve ability to make actions and intentions known to other drivers, (3) improvements in driver's ability to control the vehicle, (4) improvements in the response of the vehicle to the driver's command, (5) improvements aimed at reducing component failure, and consequences of such failure, and (6) efforts to minimize injuries to passengers in the vehicle by use of energy-absorbing materials and belts, recessing of knobs and controls, improvement of door locks, door handles, roof structure and other components.

1959 Pontiac Bonneville Safari . . . station wagon increased wheel tread 4.98 in. in front and 4.57 in. in rear to improve stability, riding comfort. Safari also features 10% increase in brake lining area, 39% greater weight drum and a cooling flange on front drums. Tempest 420 V-8 engine is rated at 300 hp at 4000 rpm; torque is 420 ft.-lb. at 2800 rpm; compression ratio, 10:1; wheelbase, 122 in.; over-all length, 214.3 in.

Pickup truck is dwarfed . . . by a 70-ton, 60-cu yd capacity earthmover-scraper developed by R. G. LeTourneau, Inc., (PE, Sept. 1, p. 23) and displayed at San Francisco's American Mining Congress. The 62-ft long, 14-ft wide vehicle rolls on 7-ft tubeless tires at speeds of 20 mph fully loaded. This is the first earthmover shown by LeTourneau since the company left that business five years ago. The company reports that this 60-cu yd machine may soon have a companion in the 100-cu yd range. Electric dc motors geared to the inner rim of each wheel drive the earth mover. Ac motors are spotted at other critical points—steering, loading and unloading mechanisms. Electrical power is supplied by ac and dc generators driven by a 600-hp Cummins diesel.

Let Someone Else Develop and License Your Invention

CAMBRIDGE, MASS.—For the company with patents but with no money or facilities to develop them, Arthur D. Little, Inc, has an Invention Management Group to do the necessary R & D work and the leg-work to license it to another company. The same opportunity is available to the lone inventor who, perhaps even more than a company, has neither the facilities nor the funds to do further development work and make licensing arrangements (PE July 28, p. 26). An even greater asset throughout the entire proceedings is the backing and name of a nationally known research establishment according to ADL.

HOW IS IT DONE?

The company selects the invention that it would like to see exploited and ADL determines the legal, technical and economic potentialities of the idea. If the invention meets these criteria, and is not a gadget but has technological originality, then ADL will do the necessary work to commercialize the invention. Any further laboratory and development work necessary to put the invention in a licensable form will be done at ADL facilities. Following this, ADL will approach various concerns who might be interested in licensing. This work is generally paid for by the client, who then owns all the results. In some cases, arrangements are made for the division of the royalties between ADL and the owner of the invention, based on ADL's R & D financial investment to get the product to the licensing stage.

ADL says that overly cautious companies have been known to manage their inventions poorly avoiding new-product opportunities if it means diversification or change in the direction of a company's business. This adds up to a lost investment because royalty income is cut off, plus a lost business opportunity for the license.

Good TV Reception Despite 2000 F Temp

SYRACUSE, NY—A closed-circuit television system capable of providing a clear picture in temperatures exceeding 2000 F has been marketed by GE's 15 Closed Circuit Television Depts here. The new system utilizes an air cooled lens that allows remote viewing of boiler flames or "hot" areas without danger of the lens melting.

The lens is house in a 14-in. steel

tube. Compressed air is blown through peep holes in the lens housing and across the face of the lens. Designed primarily for large industries and utilizes the system requires only 15 cfm of air for cooling. The lens angle of view is better than 40° and it is interchangeable with existing lenses.

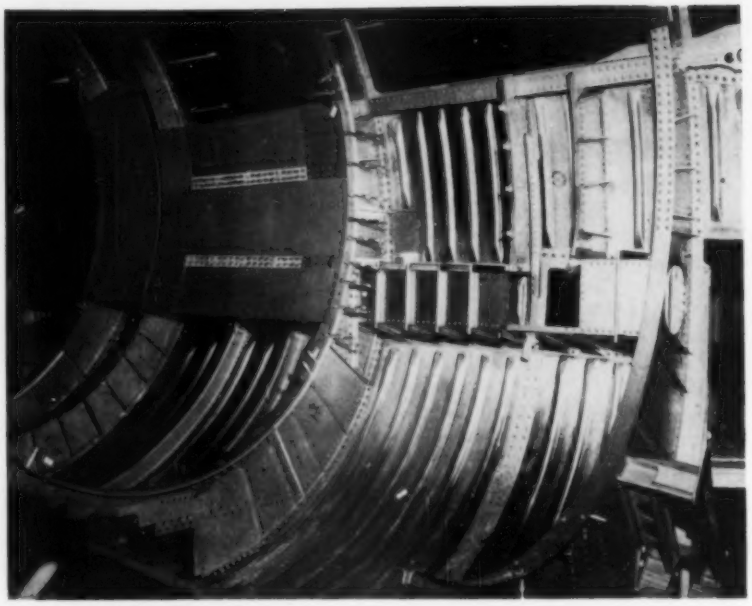
Bits and Pieces

Companies expand . . . research, engineering facilities: Raytheon Manufacturing Co has begun construction of a 70,000-sq ft, $1.7-million flight test facility to run modification and electronic tests on missiles, aircraft units and associated equipment. Philco has added an advanced weapons systems group to its Industrial and Government Div, to study and formulate systems to meet future military requirements. Convair Div of General Dynamics has set up what it calls its Datafax Instruments program to develop, refine and market instruments and instrument systems that have evolved as a byproduct of the company's work on advanced aircraft and missile systems.

Three tidal power stations . . . deriving electrical energy from the 28-ft tidal action of the White Sea, are planned by USSR, according to a report.

Aircraft cargo handling system . . . capable of both loading and unloading 90,000 lb cargo from a Douglas C-133A in 30-min is under development at Douglas Aircraft Company, Inc., for the Air Force. Support equipment specified in the Air Force contract includes roller conveyors, tracks, 53 cargo pallets, and 33 cargo cages. Pallets will be 7 by 10 ft, made of aluminum and paper honeycomb core.

Mathematical model of an optical system . . . suitable for programming on an electronic computer has been developed by Dr. Max Herzberger of Kodak Research Labs and presented in a new book, "Modern Geometrical Optics." (Interscience Publishers, Inc.) With the formulas, a designer can predict exact performance of a lens before making a sample.



Lighter-weight aft section . . .
for Chance Vought F8U-3 Crusader is accomplished by spotwelding titanium in composite construction. Here is the basic structure completed with 5 longerons plus 2 keels in the arresting hook area. Composite panels eliminate major portion of conventional frame construction, offer 30% weight reduction and eliminate sharp edges and projections.

Turn Titanium to Efficient Use in Fighter Aircraft

DALLAS—Weight of an aircraft access panel was reduced from 2.3 lb/sq ft to 1.6 lb/sq ft by using a composite construction of commercially pure, titanimum-beaded inner skins spotwelded to 8 Mn alloy outer skins instead of adding more frames, stiffeners and angles. Chance Vought Aircraft Corp used this technique to build the aft fuselage section for its F8U-3 Crusader.

Five years ago Chance Vought spotwelded titanium skins, frames, and bulkheads for the aft section of its F8U-1 Crusader. This was the first successful use of titanium in such parts. Now, though the F8U-3's aft section is larger than the F8U-1's section, it weighs considerably less per square foot. Structure of the F8U-3 aft. section see above, called for 5 bulkheads to provide attachment points for the tail surfaces, and for joining the aft section to the fuselage mid-section.

Final forming and stress relieving were accomplished in one operation by application of heat and pressure during the press forming operation for the beaded skins. Curved panels as large as 32 in by 40 in by 6 in deep have been formed successfully.

Advantages: substantial reduction in number of detail parts, improved productivity as compared to conventional titanium construction, reduction in number of fasteners, amount of titanium used; also less detail fabrication and assembly time, less weight and less maintenance time.

Automatic Engineer Replaces Hand-on-Throttle

Moscow—Some details of tests with an experimental automated railway train (PE—Aug 25, p 18) have been made public here.

Equipment replacing the engine driver is located in two small cabinets in the forward section of the front car. The smaller one contains a selenium diode memory block, a programming device with coded information concerning the profile of the railroad, the length of control railway

divisions into which the stages are divided, the time in which the train should cover these divisions, speed restrictions in certain areas, and other details for the normal run of the train along its route.

The memory block controls the functioning of the electronic computer in the larger cabinet. This is the ordering center of the automatic engine-driver.

To select and determine the moment appropriate for a change in the train's run, calculating operations are repeated until the programmed and calculated or computed information coincide. If the computed time and speed do not coincide with the programmed information, the machine will again perform the necessary calculations based on another set of input conditions.

The use of only integrating devices in the computer simplifies the control problem and speeds the solution of the traction computations. More than 190 different calculations per second can be performed by the system.

Nikolai Nikolaev, department chief of the specialized designing bureau, who is directing the preliminary tests of the first Russian automatic engine-driver said: "Two major instruments are now in operation: the computer and the memory block. The future design will combine the two into a single machine of lesser dimensions which will be installed in the front car in such a manner as to occupy very little space. But the information we get from these two instruments is as yet insufficient. To select the correct train run regimen, the machine must also know the train's actual speed at the given moment, the distance traversed from the beginning of the controlled railway division, and the time it took to cover it. Such information is supplied to the machine by counters built into the bushing of the front wheels. The counters transmit voltage impulses in proportion to the number of front wheel rpm's."

Automation of controls, he says, should exclude the erratic influence a human operation has on engine speeds. Hence, the automatic drive is expected to cut consumption of electrical energy, promote more economical use of traction engines and braking devices, ensure greater safety and add up to an increase of railway-line capacity.

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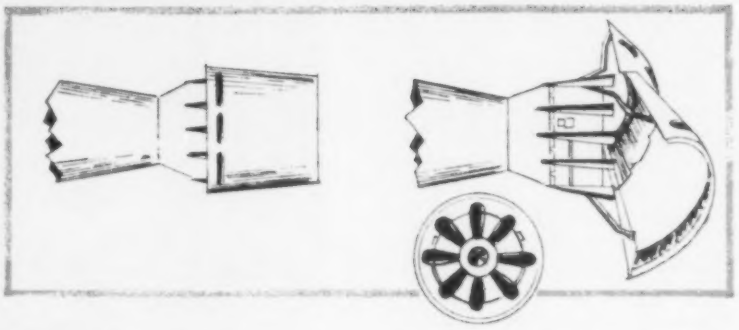


Douglas DC-8 exhaust . . . will be muffled by a fixed corrugated nozzle whose cross section resembles a daisy with eight petals, plus a retractable cylinder called an ejector, detail of which Douglas has not yet revealed. It is shown here in an artist's conception. Douglas claims that the ejector can be added to any type of nozzle to give a further reduction in sound level. It reportedly creates additional thrust, thus recovering some of the thrust lost in the nozzle, and acts as a housing for the clam shell thrust brake. In flight the ejector retracts into the engine cowling to reduce drag. High frequencies are hard on the ears, but low frequencies carry further. The Douglas suppressor shifts frequencies upward. Douglas also says that a number of "outside" factors—weather, humidity, air pressure, temperature, etc—will greatly affect results of any suppressor system.

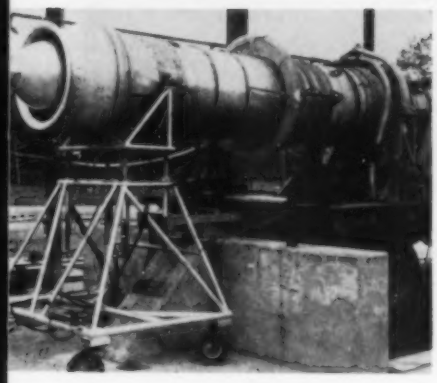
NSIA Previews Gov't Product Procurement Law

NEW YORK—The enormous importance of government both as a purchaser of industrial products and as an agency behind the design of new product is recognized by Congress in a growing body of legislation governing procurement. The status of legislation effecting government purchases was threshed out recently by the Procurement Advisory Committee of the National Security Industrial Association at the 15th annual meeting held in New York.

High on the list of upcoming legislation is the Saltonstall bill introduced in the closing weeks of the 85th Congress and expected up for serious consideration in 1959. This legislation is expected to add flexibility and competition to procurement. In ths present early version, to Saltonstall bill expresses preference for fixed price and incentive contracts. Where commercial products fit government need, the bill calls for elimination of performance specifications. (In the past, specifications have even defined standards for sports equipment.) It further sets three procurement processes—formal advertising, competitive negotiation, and negotiation. Formal advertising and competitive negotiation, the bill asserts, are equally desirable as means of increasing competition and decreasing price. The proposed legislation got blessings from NSIA speakers.

Indemnity legislation was another major interest of the committee. Technologies now maturing are leading to products in which a defect in design, material, or workmanship could cause accidents with such serious consequences that company might become insolvent in settling claims for damage to employes, outsiders or property. Four statutes—Title II of the First War Powers Act, the R & D indemnity of Public Law 557, section 170 of the Atomic Energy Act passed in 1957, and its amendment to cover the NSS Savannah added in 1958—currently guard industry against crippling losses. Up for consideration will be the Defense Department Indemnity Bill and an indemnity provision for the new National Aeronautics and Space Administration. The former allows the Defense Department to sign indemnity agreements with its contractors. Under its provisions government and industry liability for accidents will be limited to $500 million. Industry is pressing for automatic coverage for subcontractors as well.

Inlet Noise



Front-end jet noise . . .
is reduced with this bullet-shaped cone protruding from the inlet of the jet engine. Called the "sonic choke" and developed by Curtiss-Wright Corp, its principle is to set up a sonic barrier against the compressor whine. In operation the cone is extended from the inlet to a point where air entering the rounded orifice is traveling at the speed of sound, thus blocking sound waves escaping upstream. Curtiss-Wright is working with the Navy on a program of both inlet and exhaust noise and claims that by this fall will have a complete suppressor system designed to reduce jet noise by 35-55 decibels.

▼

Boeing 707 cuts noise . . .
with this multi-tube extension shown here. There are 10 large tubes on the outer edge, 10 smaller tubes towards the center, and one large tube in the center. Boeing claims a noise reduction of 12 decibels with the installation of its suppressor on the Pratt & Whitney JT3 engine. Of the many types tested, one suppressor tested contained 253 such tubes and was found to be most effective in reducing noise. However, it was necessary to obtain the maximum amount of suppression while still considering complexity, weight and drag, plus its compatibility with the installation of the thrust reverser at the tail pipe (below).

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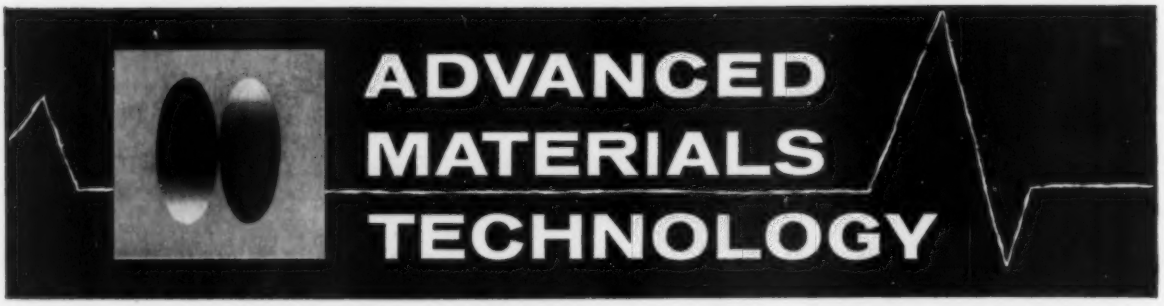

THESE CARBORUNDUM ADVANCED MATERIALS MAY HELP YOU SOLVE A DESIGN PROBLEM

Out of hundreds of new materials, many of which have come from electric furnaces, the 6 listed here offer unique advantages. A glance at the tabulation below will show why . . .

MATERIAL	PROPERTIES	FABRICABILITY	FORMS AVAILABLE	TYPICAL APPLICATIONS
BORON CARBIDE An extremely hard abrasion-resistant material produced by the reduction of boric oxide with a low ash source of carbon.	Extremely hard, 9.3 Moh's scale; good high temperature properties; practical working temperature to 4100 F in inert atmosphere, 1000 F in oxidizing atmosphere. Hot pressing or sintering produces good mechanical strength, high strength/weight ratio; brittle, subject to thermal shock; chlorinates readily in fixed or fluid bed reactors at about 1000 C.	Can be formed into solid shapes by hot pressing or sintering.	Solid, grain and powder form.	Lapping of hard metals; mold polishing and rough machining; ultrasonic machining; reactor shielding; reactor control rods; chemical (fuel, feed material).
BORON NITRIDE An easily machined, impermeable ceramic material with unique electrical and corrosion resistance properties for use up to 3000 F.	Density, gms/cc — 2.10 min. (true density, gms/cc — 2.25); working temperature: inert atmosphere, solid — 3000°F. max.; powder — 5000°F. max.; oxidizing atmosphere, solid — 1800°F. max.; powder — 1300°F. max.; dielectric constant — 4-+; dielectric strength — high; electrical resistivity — high; coefficient of friction — low; thermal shock resistance — excellent; permeability — negligible; flexural strength — good; hardness, Moh's scale — 2.	Can be machined at high speeds without lubricant with standard steel cutting tools. May be threaded or otherwise physically joined to form strong, sizeable assemblies.	Solid and powder form. Has hexagonal crystalline structure similar to graphite.	Vacuum tube separators; dielectric applications; electrical insulators; chemical equipment parts; molten metal pump parts; combustion chamber liners; melting crucibles; thermocouple protection tubes; mold release agents; gaskets; seals; rupture discs.
KT SILICON CARBIDE Extremely hard, self-bonded impermeable ceramic for use up to 4000 F.	Very hard; negligible permeability; exceptional abrasion and corrosion resistance; working temperature to 4200 F in inert atmosphere, to 3000 F in oxidizing atmosphere; high modulus of elasticity, flexural strength, compressive strength, thermal conductivity; low thermal expansion; excellent resistance to thermal shock.	Standard ceramic forming techniques can produce large intricate shapes to .007" tolerance on unground surfaces and to .001" on ground surfaces. Diamond grinding necessary for finish machining, can produce very high surface finish (5 micro-inches).	Solid form.	Wear-resistant parts; crucibles; heat exchanger parts; valves for corrosives; pipe and fittings; nuclear reactor structural parts; rocket nozzles; nose cones; leading edges.
FIBERFRAX® A fibrous insulation medium above the practicable temp range of mineral wool, glass & asbestos.	Melting point over 3000 F; maximum use temp 2300 F; low thermal conductivity; castable forms exhibit exceptional thermal shock resistance.	Extremely diverse fabricating possibilities due to wide variety of forms available.	Bulk; long & short staple fiber; batts; board; paper; blocks; castable compositions; molded shapes; roving; yarn; wicking; rope; tape; cloth; braid.	Thermal, acoustical and electrical insulation; high temperature gas filters; gaskets; packings; liners for aluminum pouring troughs; vacuum outgassing of reactive metals; protective cushion in honeycomb brazing; protective coatings for metals and graphite.
REFRAX® Silicon-nitride-bonded silicon carbide.	Average bulk density: 2.87; porosity: 7.9%; thermal conductivity @ 2200 F: 113.5 Btu; modulus of rupture @ 1350 C: 5640; excellent abrasion resistance; very high relative resistance to spalling; not wet by molten silver, copper or aluminum; good thermal shock resistance.	Can be formed into complex shapes with tolerances as low as .005"/in. possible without finish grinding. For closer tolerances, lap or grind with diamond abrasives; drill or bore with ultrasonic methods.	Brick and shapes in many instances resembling metal in characteristics.	Brazing fixtures; pumps and pump parts for aluminum and other nonferrous metals; burner tips; nozzles and blocks; cyclone-type classifier parts exposed to abrasive materials suspended in liquid and gas carriers; acid spray nozzles.
STUPALOX® A ceramic oxide cutting tool material.	Composition: aluminum oxide; hardness Rockwell "A": 92; compressive strength: to 450,000 psi; transverse rupture strength: to 100,000 psi.	Diamond Grinding. Lapping.	All Standard Tool Shapes. Special Die and gage shapes.	Cutting tools; wear parts; dies.

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Product Engineering **HORIZONS**

October 6, 1958

PLAN '59

WHY MODERNIZE ENGINEERING?

It is easy to show how better machine tools, a bigger press, a more automatic assembly line will pay off in cash savings and increased production. And at first blush this seems to be all that modernization means.

But the purpose of design, research and development—new and better products—*is* modernization. And achievement of this purpose is more important to business success than the factory, the sales force and even the management. Surely bringing uptodate equipment and methods into drafting rooms, laboratories and model shops can do as much for production economy as the ultimate of automatic fctories—both in fact and in its suggestion of modernity in ideas.

Can you prove this in accountant's facts and figures? Only by example. The most progressive and successful companies invest in better drawing equipment, laboratory equipment, model-shop machine tools, and a well-equipped library staffed by a professional librarian.

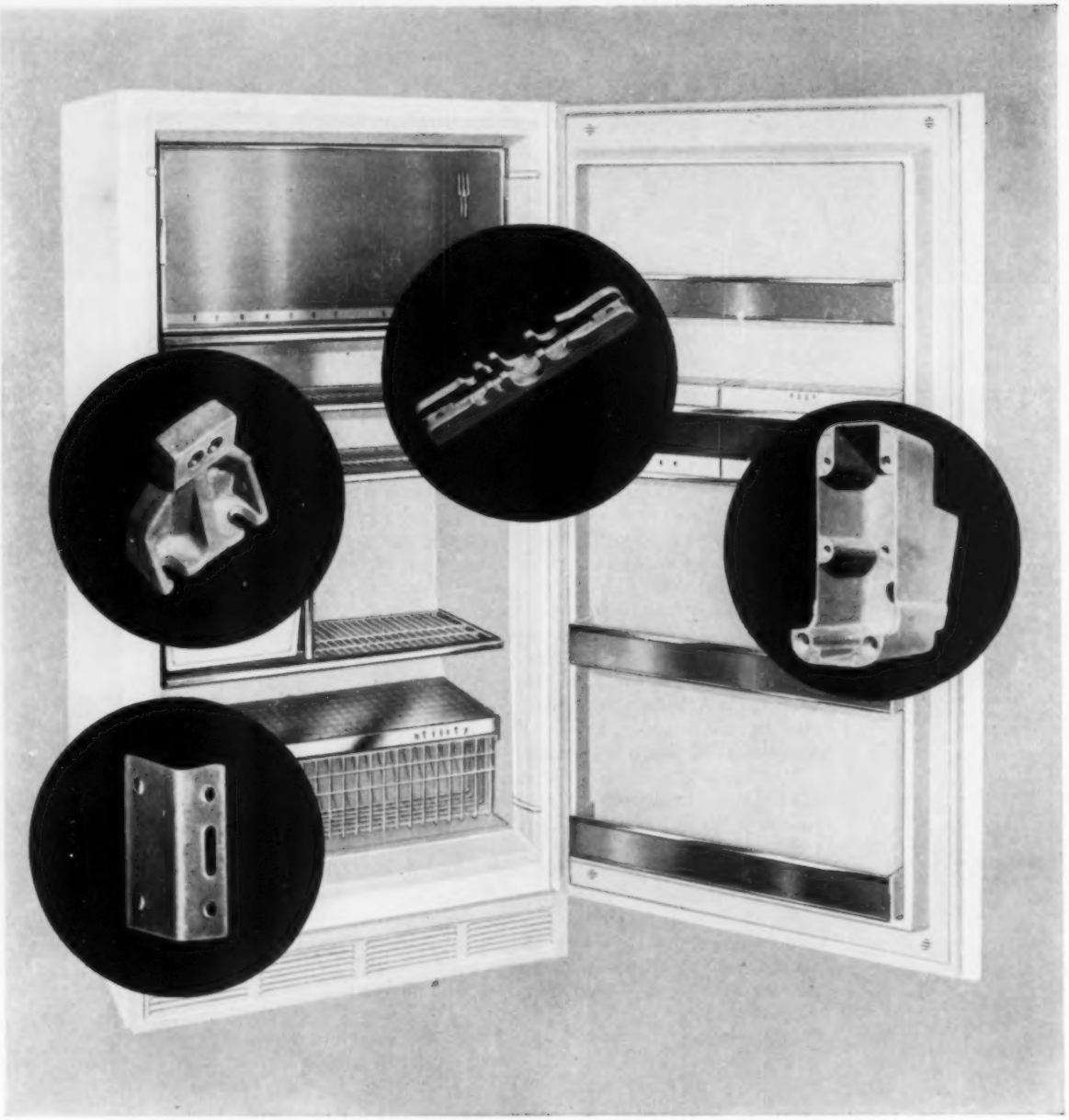
"No!" says the old timer, "Design is based on men and ideas, not drafting machines or numerically controlled back-scratchers!" True, but even the best seeds won't germinate in dry, infertile soil. Good ideas coming to engineers now on the staff may be forced to run an impassable obstacle course of obsolete equipment compounded by an antiquated organization blind to the demands of today's competition and tomorrow's customer.

But you will have to justify your suggested purchases with more than colorful words; that is the task we have here set ourselves. In this and the next issue of Product Engineering, we will help you *prove* the need for modernization in *your* department *now*, and outline *how* the necessary improvements can be made.

In this issue you will find the best figures now available on how to calculate R & D investments for your company. In interview, survey and extensive library research, Product Engineering editors have established what the engineering-laboratory minimum needs are, what a model shop can save and how a day in good engineering library may obviate a year's research.

Next week we give you the tools for engineering modernization; what types of drafting equipment, how to set up a library or a laboratory, where to have the model shop and what it should contain. Together the two reports will provide you with a working handbook of why's and how's for a truly modern engineering department.

Combined reprints of the feature articles on modernization in this and next week's issue will be available at 50¢ each as long as the supply lasts. Write to Reader Service Manager, Product Engineering, 330 W. 42 St., NY 36, NY.



Kelvinator gets big benefits from premix moldings

Premix moldings are making an important contribution to performance of Kelvinator refrigerators.

Strike mounting plates, tie-straps, tubing retainers and lock housings for the Kelvinator are all premix moldings. They've proved tough and resilient . . . excellent shock absorbers. And their thermal insulating properties contribute to the economical operation of the refrigerator.

When resins and reinforcing fibers are blended beforehand, moldings are stronger, wall thicknesses more uniform, weak spots are eliminated. Small and large, simple and complex, premix moldings are not only improving products but cutting costs for hundreds of manufacturers.

If your product calls for strong, rigid, reinforced plastics, look into premix moldings made with Dow vinyltoluene or Dow styrene. Get the names of molders and suppliers from your nearest Dow sales office or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept. 2207K.

YOU CAN DEPEND ON DOW

RESEARCH AND DEVELOPMENT

CAN IT REALLY PAY OFF FOR THE SMALL COMPANY?

Here are the actual costs, the organization, the men needed to create a small R&D department and how to make it work.

Today it is fashionable for every large-sized company to have an R & D laboratory and a staff of PhD's. Annual reports are decorated with full-color photos of a scientist sporting a bushy coiffure and pointing at a blackboard. Any project that can be described in terms of spaceships, ballistic missiles, nuclear physics or solid state is paraded as a fundamental contribution to science with as much sales potential as the transistor.

The stockholders are impressed.

Well, just how much is actually spent by industry on research and new-product development? Despite a general slump in capital expenditures, R & D continues to rise at a fantastic rate. The McGraw-Hill economics department survey made earlier this year indicates industry will invest $8.3 billion in R & D for 1958—$9.9 billion by 1961.

Impressive? Sure, particularly when you remember that these figures are double what the expenditures were three years ago.

But this survey represents the intentions of *large* companies. Small and medium-sized companies are still running scared. They think research is not for them—it is too expensive, takes a long time, is risky and really requires those PhD's. It's a lot simpler to leave the highbrow stuff to big competitors. You watch them carefully, copy their innovations and reap the benefits of substantial projects, low investment and none of the risks.

They're wrong on all counts.

R & D is a form of life insurance these days. Says one company president, "If your company plans to be in business 10 years from now, it will need to have something to sell." It's that simple.

Dr. Haldon A. Leedy, Director of Armour Research Foundation estimates that 50% of all products now being manufactured can be traced directly to results coming from a research laboratory. Further, many of the remaining products are still being sold at a profit because of improvements made by research. *(next page please)*

Dr. Guy Suits, vice-president and director of research of General Electric, refuted some well-known definitions of basic research (i.e.: "when you don't know what you're doing") recently when he posed the following questions: "Are the results of basic research completely unpredictable? Is the explorer in science entirely at the mercy of a capricious Nature? Is it hopeless to inquire as to possible or even probable areas of scientific progress? I think the answer to each of these questions is NO. . . ."

Table I—Percentage of company sales (not financed by government funds) spent on R & D

Industry	Companies employing		
	50–499	500–1000	over 1000
Chemicals and allied products	2.2	2.2	2.6
Petroleum products and extraction	*	*	0.7
Rubber products	*	*	1.0
Primary metals industries	*	*	0.4
Fabricated metal products and ordnance	*	1.6	0.5
Machinery	1.2	1.1	1.6
Electrical equipment	3.0	1.4	2.6
Aircraft and parts	*	*	1.4
Professional and scientific instruments	2.7	4.4	2.7

*No percentage available

How much for R & D?

Just how much should a company spend? This is a favorite question and in an approximate way it *can* be answered. It depends on the industry, company size and availability of funds, strength of competition, plans for future. Spend too little and the company will fall years behind its competition. Spend too much and the newer developments will never get into production.

Each well-managed research dollar will later cost an additional $5 in capital expenditures. This then is one way in which to establish a benchmark for the research budget. How much capital per year will the company be able to invest 5 to 10 years from now? Divide by 5 and you have the number of *successful* research dollars needed today. Reduce this figure by the estimated chance of success of your research program and you have a rough guess of what the yearly budget should be.

Many companies use a fixed percentage of sales to estimate research budgets. However, this percentage must be heavily influenced by the business environment, competition, and internal company needs. Table I lists such percentages as reported in a Bureau of Labor Statistics survey for the National Science Foundation.

Some research budgets are also influenced by capital assets or profits, but large budget variations may cause trouble. All executives who have had experience with R & D departments are convinced of the need for stability and continuity in a research plan. So here is another benchmark for research budgets, and probably the best one of all, "How much did we spend last year? How much can we add?"

What you'll get for your money

Each researcher or engineer will cost a lot more than just his salary. He needs equipment, space, administrative help, clerical help, power and the thousands of other minor expenses that lie in wait for the unwary comptroller.

The average engineer doing R & D has approximately these 1½ supporting personnel working under him:

- about ⅔ of a technician (lab technician, engineering aide, draftsman, etc),
- ⅓ of a skilled craftsman (glassblower, machinist, modelmaker, etc), and
- ½ in the form of administrative clerical, maintenance and other supporting personnel.

This breakdown, taken from the BLS survey, is reproduced in Table II. In addition, the engineer needs machine-shop facilities, assistance with the purchasing of standard parts and materials, accounting and a good library. (See articles on the following pages.)

The average cost of researcher or engineer in 1954 was $27,000. This included salary, the salaries of supporting personnel, direct supporting costs, plus a fair share of overhead. Prices of goods and services have risen considerably since then. Salaries, which would make up the largest part of the $27,000, have risen approximately 25% in the past four years. Assuming that other direct supporting costs have risen proportionately, today's cost of an engineer would be about $34,000 per year.

Does research begin to look expensive? Well it is, but a small or medium-sized company needn't toss in the sponge. There are several good alternatives that may be tried at much lower cost. For example, a consultant may be retained at a yearly fee, or as the occasion arises, who will keep the company abreast of technical developments or advise on specific problems. There are also instances of cooperative programs paid for by several companies, trade associations, or supplier-manufacturer combinations. While these last suffer from a lack of exclusiveness of results, often all will benefit.

Also there are many independent research organizations with staffs of specialists plus the necessary equipment to work on specific projects on a contract basis. Approximately 5% of all research and development expenditures are paid to nonprofit groups, consultants and commercial laboratories of this kind.

Table II—Supporting personnel per engineer or research worker

Industry	All	Technicians	Craftsmen	Other
Chemicals and allied products	1.20	0.50	0.10	0.60
Petroleum products and extraction	1.50	0.60	0.30	0.60
Rubber products	1.10	0.50	0.10	0.50
Primary metal industries	1.10	0.50	0.20	0.40
Fabricated metal products and ordnance	1.60	0.70	0.50	0.40
Machinery	1.70	0.70	0.50	0.50
Electrical equipment	1.50	0.90	0.10	0.50
Aircraft and parts	2.70	0.70	1.00	1.00
Professional and scientific instruments	1.10	0.60	0.20	0.30
Average	1.50	0.63	0.33	0.53

Organization

"There is no faster way to get rid of money than by ill-planned or ill-conducted research," said Dr. Vannevar Bush earlier this year. Yet despite this risk, McGraw-Hill's economics department reports that over half (52%) of the surveyed companies expect their research to pay off in 3 to 5 years and 39% estimate less than 3 years!

Good organization and an understanding management are essential if these estimates are to be reached. Most successful companies emphasize a hands-off policy—research *can't* be managed in the usual sense of the word. Making the R & D group report to any other department just won't work. Under Sales, R & D will be working on customer problems, complaints and how big a market can be expected for next year's products. Under Production it will spend all its time on equipment and plant layouts.

The research director should report directly to the president. He should be consulted and informed about company plans, policies and prospects. At the beginning of a small-company program, R & D will probably be one man's part-time responsibility. Later the budget will justify a full-time man and ultimately a formal group can be organized, completely divorced from day-to-day problems and trouble-shooting. Especially in the smaller company, the R & D department should work on formal assignments rather than at the beck and call of anyone with a problem.

The director's job isn't easy and a good man may take some hunting. He must be a strategist able to map out all of the possible areas of study and choose those with a good chance of success. He must be a diplomat and a salesman because ultimately it is the research department's responsibility to interest other departments in its projects.

How to find such a man, and to keep him? Particularly for small starting R & D groups it may not be easy. At President Eisenhower's conference on the use of research by small business late last year, the conclusion was to stress the advantages of small business over big. Individual recognition and the chance for specialized development are potent arguments. Recognize a man's professional standing by providing time and opportunity for professional advancement. Give profit-sharing and bonus awards as incentives for R & D achievement. The man with project responsibility will really produce—and happily—only when he is clearly identified with the success or failure of his project.

What about basic research?

The McGraw-Hill survey reports that 48% of the 1958 R & D budget is going into new-product development. Another 41% is going toward product improvement. The remaining 11% is earmarked for new processes. There seems to be no provision for basic research in these figures. But note that 9% of all manufacturing companies do not expect their research programs to pay off in 6 years or less. About half of this could fairly be called basic research.

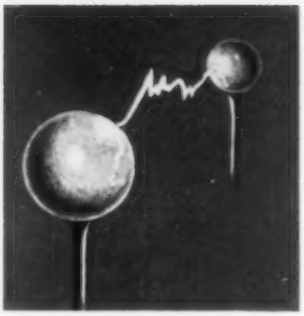
More than two-thirds of the larger companies are doing some basic research. The proportion depends heavily on the industry, with chemicals, petroleum and electronics topping the list but closely followed by the paper, aircraft, rubber and scientific-instrument industries.

And not only large companies are involved. Basic research is essential and possible for medium-sized business as well. Basic research will give a larger return per investment dollar than applied research can—it therefore represents a high-risk, high-return dollar. Isn't this precisely the province of small business?

Note that if a small company is to grow it must offer the customer more than the largest and best financed of its competitors can. That something has traditionally been service—which can be expensive—or new and improved products made possible by research.

RICHARD M. KOFF
Associate Editor

PLAN '59



Competition isn't napping. It's planning and testing tomorrow's products today. And that puts your own testing facilities on the spot. Is your lab staff big enough, equipment modern enough?

IS YOUR ENGINEERING LABORATORY STILL IN THE RACE?

"A satisfied customer is our best advertisement" now carries with it an atmosphere of yesteryear. Once it was true; now it is taken for granted that a product will perform its function. Today, products must be tested . . . components must be evaluated . . . materials must be compared. And this requires an engineering function—laboratory testing—that is taking on steadily increasing importance.

Is your engineering laboratory operation geared to faster and lower-cost product development? Is your staff adequate—in numbers and in capability? Are your testing facilities up to date—using the newer instruments, test methods, and equipment? Who has control over the laboratory, who schedules work, and is the lab being used as a training ground for product designers? Are you still doing too much product testing in the field when it could be done at lower cost—in both money and time—in the laboratory?

A survey made in preparation for this article (and the one to appear in next week's issue) discloses that 96% of the engineering departments have an established engineering laboratory. The sample was purposely concentrated in the medium-size plant, with more than half of the responses in the 500-1500 employe range.

The ratio of engineering department employes (including laboratory) to total employment ranges from 3 to 31%, but three-fourths are in the middle range of 7 to 15%. The ratio tends to be higher for smaller plants although there are some notable exceptions.

The proportion of the engineering staff assigned to the laboratory varies too widely to present a statistical summary—it runs from 1.5% to "nearly 100%." But the middle ground is between 15 and 20% of engineering employes working in the lab.

Note that this is the average or typical situation today. If you equal it, you are doing no more than the crowd. But the growing emphasis on more product planning means still greater demands on the engineering lab. Tomorrow's leaders in their field will be those with a strong design laboratory function today. And that means staff, first of all.

And the staff must have tools. What does it take to equip an engineering laboratory? Again, to get some reference point, and to make it apply as broadly as possible, we asked our respondents to suggest what it would take to equip a laboratory for a 50-man engineering department.

There is clear evidence of a basic or foundation list of instruments, test equipment and operating equipment. You'll get the detailed results next week but here are some highlights:

Each list of instruments included dimensional gages, microscope, and temperature-measuring and recording instruments; electrical measuring instruments from simple indicating types to oscilloscopes; time- and speed-measuring instruments, stroboscopes and high-speed cameras; tape recorders and noise meters.

Recommendations for test equipment almost always listed abrasion, hardness, insulation and vibration testers; and equipment for environmental testing including humidity, temperature, weather, salt spray. More than half listed sound rooms as essential.

One reply, from an engineering department of under 100, added "about $50,000 capital equipment of specialized nature to simulate field conditions." Another respondent, from an engineering department of 75, presented a specific point of view shared by several others in stating, "Any lab will need specialized equipment applicable to its special interests, such as an electron microscope, interferometer or mass spectrometer."

The function of all of this equipment and staff is to aid the designer in selecting the lowest-cost alternative that gives the desired performance. The full facts are seldom available—they must be obtained by test, under conditions peculiar to the specific problems. Instruments and testing equipment can produce the specific facts needed—in the laboratory under controlled conditions and close observation.

The engineering laboratory, properly staffed and equipped, can be a guarantee of sounder design decisions. But more than this—decisions are made at lower cost and faster when the lab is properly organized. Here are opportunities for modernization that can have long-term influence far beyond the dollars involved. ■

Design for full production efficiency: Continuous-Cast Bronze Castings.

Lower material costs, faster production, better products. Certainly a powerful set of reasons for evaluating Asarco's unique process of casting shapes in continuous lengths. The alloys produced by continuous casting are in accord with SAE, ASTM, and government specifications but their performance is demonstrably superior to similar alloys cast other ways. So superior in hardness, tensile, yield, and impact strength, that you may be able to substitute an Asarcon bronze for a high-cost aluminum or manganese bronze. You get the shape you need in the exact lengths you need, with minimum clean-up necessary, machinable on high speed machines. Immediately available in 260 *stock* sizes: Asarcon 773 (SAE 660) Bearing Bronze, solids and tubes, in lengths up to 105 inches. Write today for free booklet on Asarco continuous-casting to Continuous-Cast Products Department, American Smelting and Refining Company, Barber, N. J.; on the West Coast, Kingwell Bros., Ltd., 457 Minna St., San Francisco; in Canada, Federated Metals Canada, Ltd., Toronto and Montreal.

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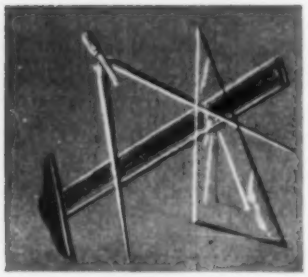


PLAN FOR EFFICIENCY WITH... MODERN DRAFTING EQUIPMENT

Time is money—10 to 25 cents per man-minute—but space is money too. New equipment will help save you dollars both ways.

Would you be willing to spend $50 to get that bracket you just designed drawn up on a sheet of paper, 11 x 16 in.? Probably not. But most companies are paying that—and more—simply transferring engineer's ideas to a working drawing. And as salaries for lab assistants, draftsmen and other technical help continue to spiral upward, the money invested in a simple piece of paper climbs to a more and more significant figure.

It's not only the draftsman's salary that's on the increase—the number of working hours bought by that salary slides continually downward. Studies show (*PE—June* '57, *p* 166) that vacations, sick leave, coffee breaks and the decreased working week have taken a 50-man-day bite out of the working year when compared with the working year of 20 years ago. Add these two factors—increased wages, decreased working time—and you have drafting time over four times more costly than in the day of the five-cent nickel. Cost-of-living adjustment only partially offsets such increases.

Yet many companies still operate drafting rooms in the same way, with the same equipment that was used in 1935. Modern drawing-room equipment won't do the drafting for you—it still takes a man behind a pencil. But modern equipment, designed for efficiency in 1958—not 1935—can go a long way to cut the rising costs.

Machines save time

Research showed recently that drafting time can be cut nearly in half if parallel straightedge and triangles are replaced by a drafting machine on an upright board. Yet many companies continue to use straightedges. The reasons they give are good ones: "You can't draw long, straight lines with drafting machines . . . the machines aren't rigid enough for accurate layout"; or, "Counterbalanced machines are a hazard when used in a horizontal position—in addition to being awkward to handle."

But the new track-type machines seem to answer all these objections. Such machines are not a new idea. Both the arm-type and track-type have been available since the turn of the century. But modern machines are more versatile, more rigid, better designed for drawing requirements of 1958. Draftsmen can use the track machine to draw long, parallel lines—over 20 ft with a really big machine—and overhanging counterbalances are unnecessary.

Another frequent objection to drafting machines is voiced by the draftsman himself. "I've used a straightedge and triangles for 20 years," he says, "I can't work fast, or as well, with a machine." Some companies are combatting this argument with short training courses that stress convenience of the equipment that puts all drafting tools—triangle, protractor, straightedge and scale—comfortably in the left hand.

Modern drawing-room furniture is another time-saver. Drawing boards and reference tables can be arranged in a number of configurations designed to cut waste motion to a minimum by putting all tools and reference material at the draftsman's fingertips. Modern boards are easily tilted to any angle; can be raised and lowered for comfort in either standing or sitting position. And when proper machines and furniture are made available, supervisors notice that more and more boards are tipped up to the steeper, more comfortable—and speedier angles.

Furniture saves space

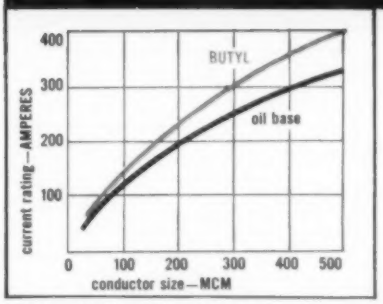
Up-to-date boards and tables are important space savers too—sometimes saving as much as 40%. Cost of office area averages about $4 per sq ft annually. So why pay for wasted space . . . or make a $30,000 addition to the plant to accommodate increased drafting force—when up-to-date tables or drawing boards will allow more draftsmen in the same area? It's cheaper to install modern equipment than to build buildings.

Saving space and time aren't, of course, the only reason why an investment in modern drawing equipment pays off. Modern equipment is attractive; makes a pleasing, well-ordered room. Draftsmen appreciate the rewards of status associated with attractive modern furniture. Little things—a desk instead of a reference table, a phone, a chair (at a chair-height board) instead of a stool—make draftsmen happier and easier to hang on to.

Nor are drafting machines and modern furniture the only new equipment which will save money in the drafting room. Templets, lettering guides, new kinds of paper faster reproducing machines have all been geared to help you increase your present margins in 1959. ■

ENJAY BUTYL

BEST WAY TO HANDLE ELECTRICITY



Butyl's outstanding resistance to heat allows considerably higher currents for any given conductor size.

Of all vulcanizable rubbers, Enjay Butyl offers the best electrical and dielectric properties. Butyl is the ideal material for wire and power cable, transformers, tapes, busbars and other insulation applications.

Butyl *also* offers outstanding resistance to weathering and sunlight . . . chemicals . . . abrasion, tear and flexing . . . superior damping properties . . . unmatched impermeability to gases and moisture.

Find out how this versatile rubber can improve your product. Call or write the Enjay Company, today!

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PLAN '59

COMPANY LIBRARIES STRETCH R & D FUNDS

Conduct library research before starting laboratory research, warns the author. The answer to a baffling problem may be within arm's reach of your librarian.

A dollar's worth of library time is sometimes worth much more than two dollar's worth of engineering time. Many companies have found this out the hard way. In one case, a group of industrial laboratories went through five years of work and nearly a quarter of a million dollars to research equipment that would translate written matter electronically. Russian scientists, it was learned later, had already tussled with this problem and the results of their efforts were easily available.

No less a financial giant than General Electric spent countless dollars investigating methods for producing man-made rain by seeding clouds with dry ice and silver iodide crystals. After two years of work it was found that similar research had been reported in Holland—20 years earlier.

Industry shops for books

"Man's judgment is no better than his information." That's how the president of the A. O. Smith Corp put it recently, in speaking of the technical library maintained by his company. Such information, he indicated, depends upon effectiveness of the technical library, "a service which is, and always will be, of utmost importance to the research program." Statistics further indicate growing support by management. In 1953, 2489 listings were in the Directory of Special Libraries compiled by the Special Libraries Association of New York. Today there are over 3000 of these libraries—almost triple the number of a decade ago—and by far the bulk of them are operated by private industry.

Steadily rising R & D budgets mean that more and more money is being spent for development of new processes and new products for diversification—areas where the company's bookshelves pay handsome profits. To stay in the swim, companies must earmark part of these funds for the library.

Skimp now—pay later

To shortchange the library budget today may mean the difference between black ink and red ink in the company ledger tomorrow. Library costs are not cheap. A skilled librarian is a professional in the same way as an engineer, chemist, or research scientist. His ideas, as they pertain to the library activity, should be carefully weighed by management, not brushed aside as expensive, unnecessary frills. In some organizations, the librarian is regarded with such importance that he reports directly to the director of research.

The tools of librarianship—reference books, indexes, abstracting services and other sources of published information—are expensive too. A complete file of Chemical Abstracts, for example, now costs in excess of $1000, and yet, if the library is to function effectively, such sums must be spent. A competent librarian will choose these and other tools, picking those which best fulfill the mission of your particular library.

But there is more to efficient library service than investment in capital goods and competent personnel. Engineers must be persuaded to use the service and they must realize that their library is alert and ready to help.

The library's reputation is its best sales weapon in getting engineers to use its facilities. Helpful, efficient personnel with facts, seemingly at their fingertips, are a strong inducement for a return visit.

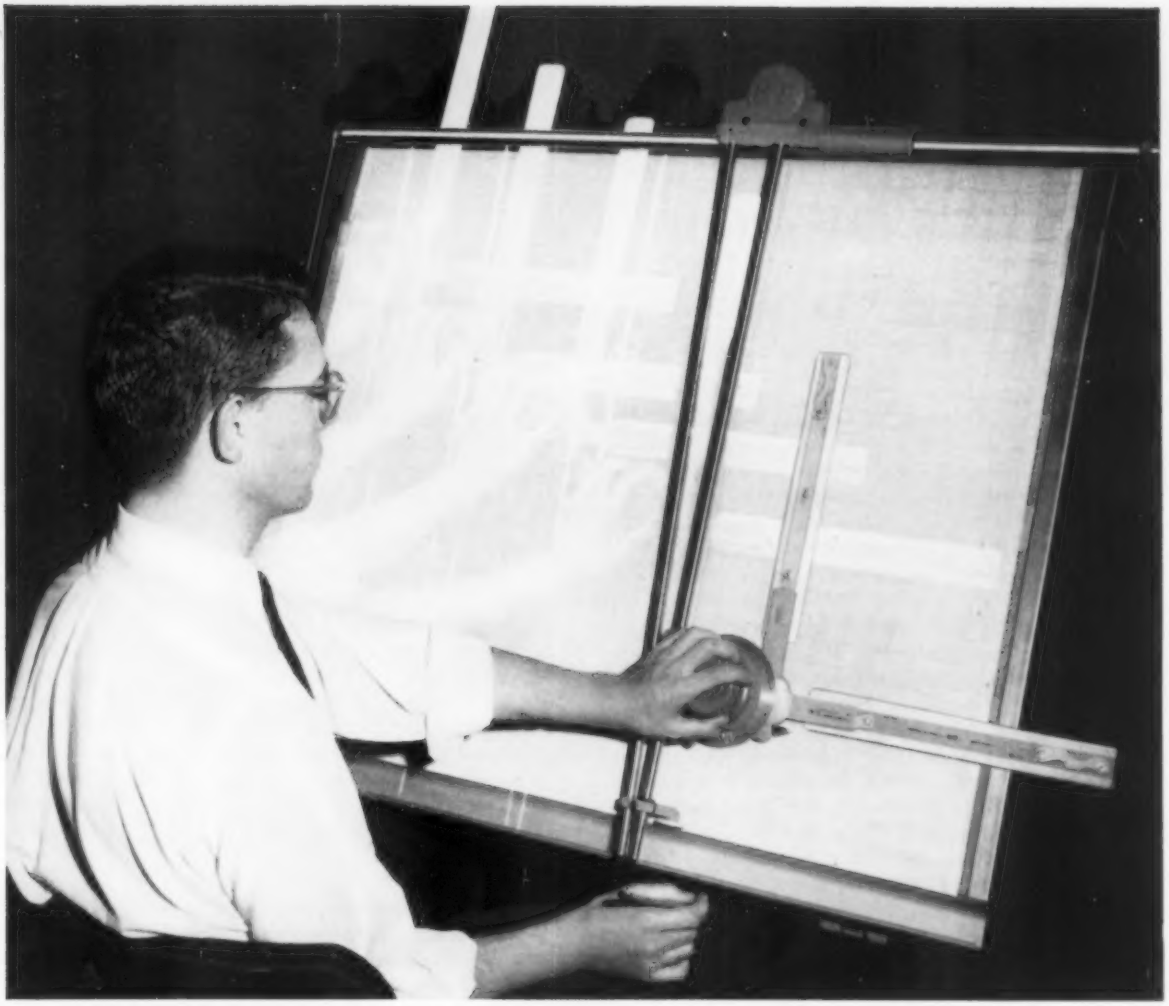
Work done on new engineering projects is a combination of engineering research and library research. In dollars-per-fact, library research is much the least expensive of the two. ■

HAROLD S. SHARP,
Chief Librarian, Farnsworth Electronics Co.

"A Leg Up" for Russian Engineers

Incidental intelligence from Russian-speaking scientists over here, tells us that the Russians have stopped using their verb form for "to compete." They have substituted an infinitive which, when translated, means "to stand on the shoulders of those who have gone before."

The Soviet Institute of Scientific Information, by collecting and synthesizing recorded information, has been spectacularly successful in providing USSR scientists and engineers with essential scientific information—"shoulders" to stand on. The lesson is plain. Given all available background data, our problems become easier to solve, and time is not wasted duplicating work already done. An efficient company library, conscientiously exhausting all available resources, can start engineers on a problem where others have left off.



...for as little as $148.50

New K&E Paragon Auto-Flow gives you faster, easier drafting 5 ways...

The first time you use it, you'll know that K&E's light-weight Paragon® *Auto-Flow*™ Drafting Machine is a truly great advance in working ease and range. Here are 5 *specific* reasons why.

It's more versatile. Stays in perfect balance at any board angle, from vertical to horizontal. No adjustments needed, except a simple turn of a tension spring wheel for angles below 15 degrees.

It's more compact. The balance is built right into the machine itself. There's no need for counterbalances that project over the top of the board.

It's better made. Glides smoothly and easily on finely-ground, stainless steel rails with K&E precision and quality in every detail.

It's more adaptable. You get a full sweep of every size of board.

It's far easier to use. The scales move smoothly, at the slightest touch. Long lines up or across can be drawn in a single motion. Scales lock in place to eliminate "drift". Greater rigidity produces truer lines.

The 30" by 40" *Auto-Flow* costs only $148.50 . . . the 36" by 60" only $160. All standard sizes; left-hand models available. Mail coupon for details. 1265

KEUFFEL & ESSER CO. Dept. PE-10 Hoboken, N. J.

☐ Please send information on the new K&E Paragon *Auto-Flow*. ☐ Please arrange a demonstration for me.

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Company & Address: _____

_____

PLAN '59

MODEL SHOP SAVES DEVELOPMENT TIME

Many companies, large and small, feel that model makers give an important boost to the design staff. We asked them why.

Let's call it the ABC company. A typical manufacturing organization, it isn't very large: 900 employes, 75 of them engineers; and about 200,000 sq ft of plant area. ABC makes small pumps and has just recently branched out into a line of specialized compressors. But what interests us is the company's model shop.

Here we find four drill presses, three lathes, two milling machines and a variety of other typical metal-working tools. Full-time staff consists of two trained modelmakers and a young machinist. They do most of their work on developmental models—new types of pumps or standard pump designs modified with new materials to fit some special application.

Why the model shop? "Three years ago," says the engineer in charge, "before we bought these machines and set aside an area exclusively for model building, we farmed out most such projects. Or if the job was small, we would sometimes steal half a day on one of the production machines. This interfered with production schedules and the production people were always in our hair or on our backs. Subcontractors weren't a good answer as too much time was lost between their shop and ours.

"It's different now," he said. "Engineers supervise modelbuilding right at the elbow of the model maker."

Expensive—but cheap

But isn't this costly? If an expensive machine sits idle half the week it isn't very economical, is it?

"No," said the engineer, "it certainly isn't. But balance that loss against the time saved—or the money saved when impractical ideas or design errors are stopped before they reach the really costly stage. Time savings alone will balance the loss. Our philosophy is this: When the design group comes up with the rough design for a new product, every day that product is not on the market the company is losing money. And if too much time is spent in development, it may never make money at all."

Many companies, large and small, have also found that a model shop, far from being a luxury, is a necessity. Some feel this shop has almost as important a place in product design as the engineering staff. One medium-size industrial design outfit allots half its floor space and capital investment to model-shop activities and half to engineering. It has found that engineers learn more from models than from drawings—are able to see flaws, improvements, or can suggest changes for ease in manufacture. Completion of the first model often marks only the half way point in the design process.

Model shops can tackle a variety of jobs. Developmental models are the most common. These test a principle of operation or a new material. Another place where the model shop helps out is for building unusual test equipment and one-of-a-kind experimental apparatus. At some companies, full-scale, wood-and-clay appearance models are major output of the model shop. In addition, these shops usually take on working models, which mimic the action of a proposed machine, and reduced-scale models for display or promotion.

But the model shop must not be turned into a catch-all for small machining jobs or a shop for equipment repair. Skilled modelmakers are expensive and hard to find. It is wasteful and an insult to a craftsman to give him a job that does not utilize his ability or tax his skill. Repairs and routine machine work should be done in a machine shop set up for that purpose and staffed with machinists —or it should be farmed out.

Do it yourself

Why not farm out all modelmaking work? There are several reasons. First, drawings at this stage of the game are very likely to be incomplete: dimensions missing, standard parts not shown in detail—perhaps they're only a rough sketch on a piece of squared paper. If the job is done outside, the vendor will want the drawings in detail and that means additional time. Even then, errors will show up and time is spent in communication between company engineers and vendor's machinists before getting difficulties ironed out.

In addition, your own shop will take a personal interest in the product that an outsider wouldn't have. Modelmakers get to know the engineers they work with and can make constructive contributions. They often give suggestions that make the product more manufacturable.

Security is another reason. In government work the vendor has to be cleared—this eats up time. And for reasons of company security, unpatented prototypes and experimental models should be circulated as little as possible.

Although it saves money in the long run, a model shop is not an inexpensive venture. Top-grade toolroom machinery and skilled craftsmen cost money. One model-shop manager puts it this way. "For real economy you want the best equipment and personnel the company can buy. This is not the area to save money. Back of each model is a staff of people—engineers, draftsmen, technicians. Any delay delivering the model means holding up these people. Saving time is much more important than saving model-shop costs." ■

CIRCLE 66 READER SERVICE CARD →

No fasteners needed: hinged lid assembled within one-piece neoprene frame

The double frame of this ice cream cabinet lid—including hinge, lip seals and knobs—is a one-piece molding of neoprene synthetic rubber. Stainless steel panels and urethane foam-in-place insulation complete the design; not a single fastener is required.

Bottom panels are molded into the vulcanized neoprene frame. Neoprene adhesive is applied to the interior surfaces of the steel panels and urethane foam is poured into the cavities. The foam sets at room temperature to provide a lightweight insulation and stiffener. Tests of this lid have included 200,000 slammings with no flex-cracking in the neoprene hinge or other damage to the unit.

Du Pont neoprene is specified for the frame because it offers good mechanical properties; resistance to butterfat, shortening and fruit acids; and resistance to strong detergents and hot water. The frame is easy to clean and has no crevices to catch dirt.

Investigate the design possibilities of neoprene. It has a combination of properties which mean superior performance for many products: properties including resistance to oil, heat, many chemicals and weather. Send the coupon for more information on neoprene and two new Du Pont elastomers: HYPALON® and VITON.

ELASTOMERS IN ACTION HYPALON® • NEOPRENE VITON TRADEMARK

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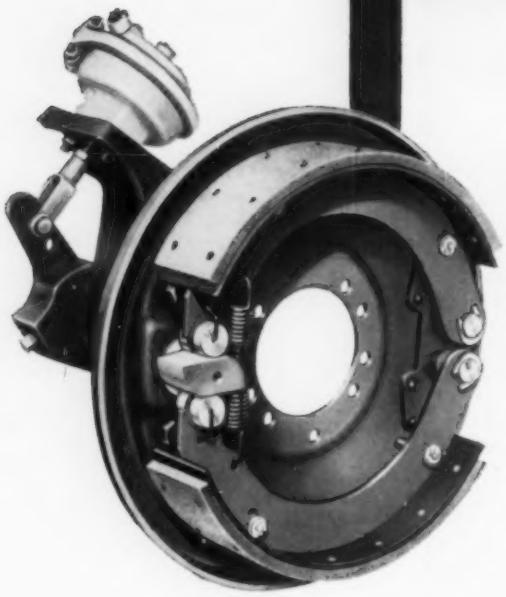

"T" BRAKE

...an economical air brake designed for a variety of automotive applications

If it moves...

ROCKWELL-STANDARD

BRAKES CAN STOP IT!

Outstanding control for a modest investment is offered by the new "T" air brake. Ruggedly-built, dependable, and capable of long, trouble-free service, its economy is achieved principally through simpler design and improved manufacturing methods.

Air-actuated, the "T" Brake operates through a precision-forged, one-piece camshaft. The cam design provides a constant, equal rate of lift to both shoes. The entire camshaft is heat treated for maximum strength.

Fabricated steel brake shoes combine strength with lightness... hardened spool type cam rollers used with single-web, fabricated shoes provide perfect alignment with camhead. The roller, mounted in an open-type support, is always free to rotate. Brake linings are available up to ½" in thickness.

Other features include: quick, one-point adjustment; air chamber and camshaft brackets mounted on backing plate in one compact assembly; wide range of sizes and capacities.

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BRAKE DIVISION Ashtabula, Ohio

ROCKWELL R STANDARD

For every industrial, agricultural or automotive application where braking is required!

SIGNIFICANT COMPONENTS • MATERIALS • PROCESSES

Bright silver-plating process . . .

has hardness of 135 Brinnell, is highly ductile and tends to age-harden up to temperatures of 212 F. Plating-solution bath operative at room temperature. Process employs a clear, water-white solution that permits plater to watch work in production. Requires only one brightening replenisher. Said to give uniformly good results at current densities from 5 to 40 amp per sq ft. Most silver-plating solutions can be easily converted to this process. Basic additive is about $13.50 per gal. in small quantities; replenisher, about $17.50 per gal. From stock. **American Platinum & Silver Div., Engelhard Industries, Inc, 231 New Jersey Railroad Ave, Newark 5, NJ.**

Circle 11, Reader Service Card

Single-phase motors enclose controls . . .

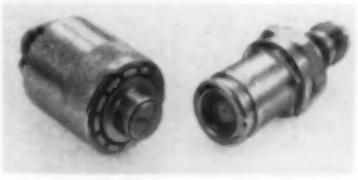
in end bell (see cutaway view), completely sealing switch assembly, starting capacitor, thermostat, terminal board from ventilating airstream. Starting switch has self-cleaning scissor-action contacts and is actuated by governor through a nylon button. Distance between bearing centers has been reduced, improving concentricity and minimizing electrical noise. Pre-lubricated and sealed ball bearings are made to low noise specs and are locked to shaft, limiting end-play to tolerances within bearing. Rotor is shrunk-fit to shaft. Available in general purpose, 56 frame with rigid base—¼ through 1½ hp; also as blower motor in 56 frame with resilient mounting—¼ through 3 hp (capacitor mounted on top of frame in motors over 1½ hp). Production starts mid-November. Prices comparable with open flip motors. **A O Smith Corp, Tipp City, Ohio.**

Circle 14, Reader Service Card

Monitors heat, or counts . . .

by it, operating at a distance of 6 in. to many feet away from heat source. Reacts only to radiation. Optical system focuses infrared radiation on a photocell whose output signal is amplified, triggering an electronic relay that can shut off a heater, sound an alarm or perform other tasks. Relay can handle 5-amp load. Switching point can be varied; standard operating range is 950 to 2000 F. Repeat accuracy is said to be 0.5% of scale under normal operating conditions. Standard model available from stock; $285. **Mason Instrument Co, 29 Elm Ave, Mount Vernon, NY.**

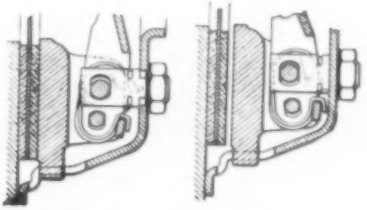
Circle 12, Reader Service Card



Quick-disconnect coupling . . .

for hydraulic and fuel lines in aircraft and missiles is reported to have withstood 22,000-psi burst pressure. Coupling may be connected and disconnected manually under high pressure with negligible loss of fluid. Coupling pushes together and disconnects by pulling back on actuating ring. Remotely actuated couplings are also available. Locking mechanism compensates itself as wear occur to maintain full 360° gripping action. **On Mark Coupling, Inc, 4440 York Blvd, Los Angeles 41.**

Circle 15, Reader Service Card



Inverted lever operates . . .

spring-loaded clutch assemblies and is said to result in less friction and wear. Rolling fulcrum pin-action in the release lever permits smooth release and lever automatically returns to original position after engagement of clutch. Levers are balanced to avoid throw-out at high speeds. Clutch automatically compensates for facing wear. Driven member is offered with solid or dampener arrangement. Various facings are available. **Rockford Clutch Div, Borg-Warner Corp, Rockford, Ill.**

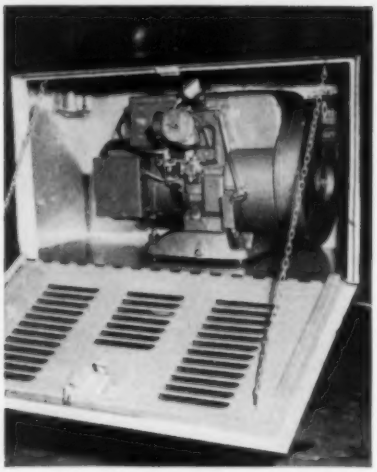
Circle 16, Reader Service Card

Sintered bronze bearing . . .

is pressed from round-particle powder, and said to provide longer, larger lubricant storage areas for molybdenum disulfide and silicones, with which they are impregnated. Ultimate compression strength is 22,700 psi; tensile, 7000 psi; coefficient of linear expansion, 17×10^{-6}; elongation, 7%. Available with ¼ to 1½ in. OD in 6-in. lengths. $1.25 to $12.50, depending on size; delivery, 3 wk. **Booker-Cooper, Inc, 6940 Farmdale Ave, N Hollywood, Calif.**

Circle 13, Reader Service Card

ELECTRIC PLANT NEWS



Charges truck batteries at far less cost . . . provides A.C. power, too!

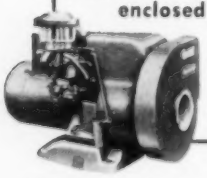
Before the dual-purpose Onan Electric Plant was installed on this maintenance truck, it was necessary to run the 160 H.P. truck engine to charge batteries for communications. Now, the 2 H.P. Onan Electric Plant does the same job . . . saving fuel and engine maintenance.

These battery charging-A.C. combination electric plants are available with 1,000 or 2,000 watts of A.C. output for operating tools and lights. Either size also delivers a full 30 amperes . . . enough to handle battery drain from radio and lighting.

Big savings reported!

One utility makes fuel savings alone estimated at $2.00 per day per truck. Another cites an annual saving of $800.00 per truck. This is based on battery charging output only. In addition, the A.C. output makes possible replacing hand tools with electric tools . . . saving time and money.

Vacu-Flo cooling permits enclosed installations



Vacu-Flo cooling is a low-cost optional feature on Onan air-cooled plants up to 10,000 watts.

Other Onan Models 500 to 200,000 watts A.C., D.C. and Battery Charging.

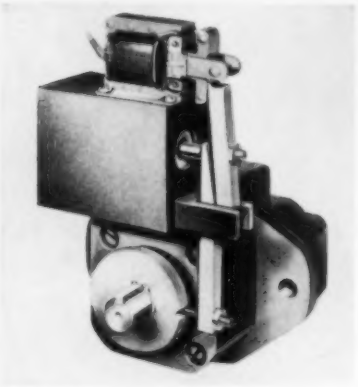
Write for folder showing 3 Packaged Power Systems

Onan ELECTRIC PLANTS

D.W. ONAN & SONS, INC.

3654A University Ave. S.E. Minneapolis 14, Minn.

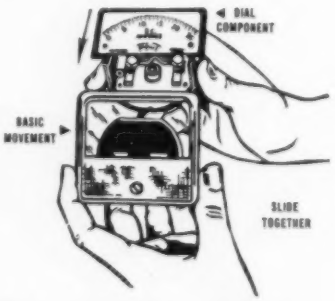
SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .



Fluid power 1-rev drive . . .

has built-in value to compensate during movement and unload while stationary. Cam and adjustable finger lever arrangement permit rapid and smooth acceleration and deceleration as well as positive stop. Starter is solenoid-actuated, but drive may also be arranged for manual or mechanical starting. Multi-revolution operation unit is also available. Dimensions are about 6 x 5 x 7 in. high. Offered in a wide range of output torque capacities and speeds. Applicable as an intermittent drive for indexing motions, turntables, office equipment and other units where instant high torque is desirable. **John S Barnes Corp, 301 S Water, Rockford, Ill.**

Circle 17, Reader Service Card



Dial components combine . . .

with a separate basic movement section to permit flexible inventory of panel meters without excessive cost. Assembly process is said to be error-proof and to take 5 or 6 sec. The two sections slide together and lock with a thumbscrew on back of unit. Meters have self-shielded bar-ring movements, ac and dc linear scales, dustproof construction and instant conversion standard mounting. Also available in three standard kits. **Triplett Electrical Instrument Co., Bluffton, Ohio.**

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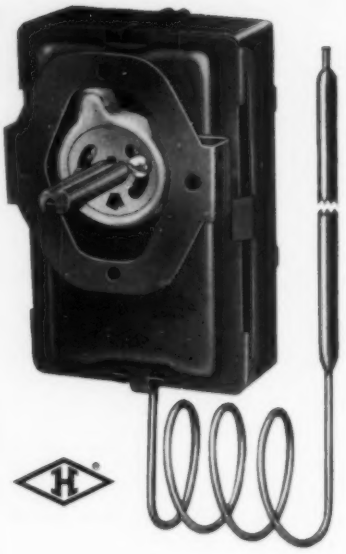

"DIAMOND H" THERMOSTATS

For range ovens, appliances, motor or solenoid control, restaurant and laboratory equipment, industrial and air conditioning applications.

A wide variety of circuits and temperature ranges are available in both single and double pole models of "Diamond H" Series 270 Thermostats with UL-approved ratings up to 25 A., 125-250 V., A. C.

They may be had with single dial control, on-off, manual and automatic preheat and sequencing. Calibration is accurate with consistent, low differential and positive, over-the center, snap action. Spade terminals simplify assembly; screw terminal adapters available. Spindles and mountings as required. Ask for Bulletins T270 and T276.

For a quick run-down on "Diamond H" switches, relays, thermostats and other devices, send today for a free copy of the "Diamond H" Check List of Reliable Controls.

THE HART MANUFACTURING COMPANY

206 Bartholomew Ave., Hartford 1, Conn.

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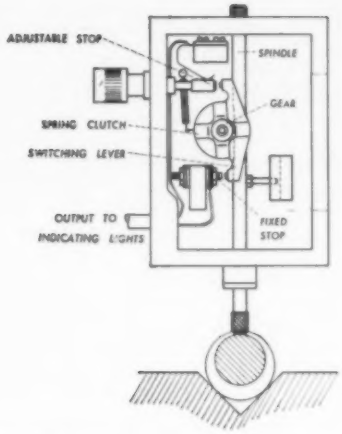
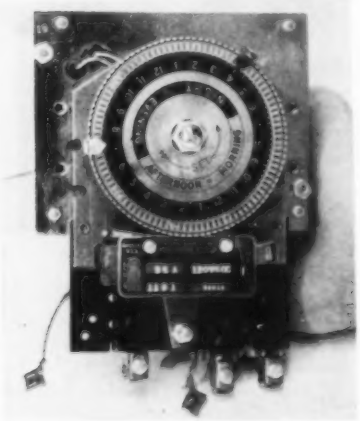


Spindle-actuated indicator . . . operates as a switching mechanism, which, combined with signal lights, indicates position, travel, eccentricity, lack of squareness or wobble. Can be applied to automatic as well as manual systems. Dimensions of 2¾ x 2⅛ x 1³⁄₃₂ in., including adjustable stop-knob, permit stacking for multiple measurements. May be mounted in any position without loss of accuracy. Light weight design is said to permit device to follow variations accurately, without vibration or bounce, even at high speeds encountered in automatic gaging. **Federal Products Corp, Providence, RI.**

Circle 19, Reader Service Card



Reserve-power time switch . . . requires no winding and maintains on-time operation during prolonged power failures or in event of series of failures within short span of time. Reserve action is provided by spring, electrically wound by switch's motor. Release mechanically exercises reserve spring daily to keep it in condition. Reserve is said to be capable of keeping switch in operation for up to 17 hr. When power is restored, normal ac operation is resumed and spring rewinds fully within 2 hrs max. **Tork Time Controls, Inc, Mount Vernon, NY.**

Circle 20, Reader Service Card

look at these advantages of

IRIDITE® FINISHES

for

CORROSION-RESISTANCE, PAINT BASE on ALUMINUM and MAGNESIUM

TYPICAL APPLICATIONS

Aircraft and Missile Parts

Automobile Hardware

Outdoor Furniture

Communications Equipment

Marine Equipment

EASE OF USE—Iridite is a simple chromate conversion treatment. Fast, easy, economical. You just dip, brush or spray it on the part at room temperature. No special equipment. No specially trained personnel.

OUTSTANDING PERFORMANCE—Forms a film that is an integral part of the metal itself. Can't flake, chip or peel. Takes paint firmly on initial application, and the bond lasts. Even protects areas scratched in use.

LOWEST COST—You have only minimum equipment cost, no special racks, high speed operation, lower overall handling costs.

CHOICE OF APPEARANCE—Clear coatings that retain metallic lustre to dark, maximum protection coatings. A variety of colors is available by dyeing.

IRIDITE # 14 and # 14-2 (Al-Coat) for ALUMINUM

Two specially formulated finishes that give you maximum latitude in aluminum treatment. Both provide excellent corrosion protection and paint base. Iridite #14-2 is an improved product that allows greater flexibility in operation and coating thickness and produces the optimum in corrosion protection.

Either coating provides corrosion resistance superior even to complicated electrolytic treatments in a fraction of the time. These coatings also offer many other valuable characteristics: they have low electrical resistance, they aid in arc-welding, provide a good base for bonding compounds, have no effect on the dimensional stability of close-tolerance parts. Final appearances ranging from clear through yellow iridescence to full brown can be obtained. By dyeing, you can produce red, green, blue, orange or yellow finishes.

IRIDITE # 15 for MAGNESIUM

Produces a protective, paint base film with corrosion resistance at least equal to that obtained from long, high-temperature dichromate treatments in a fraction of the time and at room temperature. The appearance of the coating can be varied from light brown to dark brown and black.

APPROVED UNDER GOVERNMENT AND INDUSTRIAL SPECIFICATIONS

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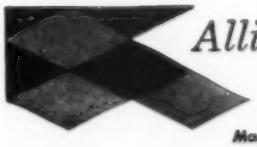

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For further information, please check:

☐ RULON S-Liner data sheet and prices

plastics division: Dixon Corporation

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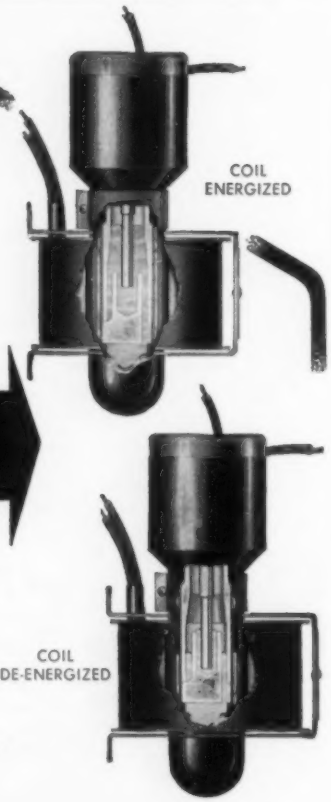

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See telephone directory for local distributor, or write.

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Miniature photocells . . .

are said to offer a sensitivity to light flux about 1 million times that of high-vacuum photoemissive tubes. Line of 13 cells is said to be responsive, as a group, over entire range of visible spectrum and somewhat beyond. Each cell has a rectangular sensitive surface about $\frac{3}{16}$ x $\frac{1}{4}$ in. and can be supplied with end- or side-view. May be soldered directly into circuit. Polycrystalline cadmium sulfide or cadmium selenide photoconductive elements are hermetically sealed in glass or encapsulated in plastic. Over-all length of each is 1 and $\frac{1}{2}$ in., respectively. Power dissipation is 50 milliw for plastic units and 75 milliw for glass units, with ambient temperature ranging from —58 to 167 F. **Clairex Corp, 19 W 26th St, NYC.**

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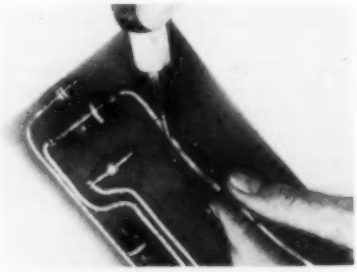

Resin-backed copper strip . . .

can be used to make printed circuit prototypes that can be punched, drilled and solder-dipped without damage. Corrugated flexible strip applies to any plastic laminate with regular soldering iron. Strips are available in thicknesses of 0.004 to 0.005 in.; 0.064 in. wide. Min bend radius is 0.250 in. Resistance is 0.06 ohm per ft. Max overload current is 15 amp. Resistant to water and solvents. 2-oz copper strip in 50-ft rolls is packaged in a dispenser case. **Redel, Inc, 220 N Atchison St, Anaheim, Calif.**

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Digital tachometer . . .

provides direct readouts to within ±1 rpm even at high rotational speeds. Magneto-restrictive delay-line times gate that opens counter to read rpm in luminous numerals at desired intervals, without interfering with rotation of shaft. Reads in times-one (×1) position any rotational speed to 9999 rpm; in times-two (×2) position, readout is multiplied by two; in a third position, reading is for a percentage of a given rpm that has been set on calibrated scale. Power source is 400 cps. **Deltime, Inc, 608 Fayette Ave, Mamaroneck, NY.**

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INDEX TO ADVERTISERS

Allied Research Products, Inc. 37
American Cyanamid Co., Plastics & Resins Div. 3
American Smelting & Refining Co., Continuous Cast Dept. 27

Carborundum Co. 20
Chemical & Power Products, Inc. 14
Chicago Molded Products Corp. 40
Crane Packing Co. 17

Dixon Corp. 38
Dow Chemical Co. 22
du Pont de Nemours & Co., (Inc.), E. I., Elastomers Dept. 33
du Pont de Nemours & Co., (Inc.), E. I., Polychemicals Dept. 13
Durakool, Inc. 38

Enjay Co., Inc. 29

Fluidwick Co. 40

Hart Mfg. Co. 36

Keuffel & Esser Co. 31

Link-Belt Co. 6

Miniature Precision Bearings, Inc. ..... 4th Cover
Moraine Products Div., General Motors Corp. 4

Nylok-Detroit Corp. 18

Onan & Sons, Inc., D. W. 36

Phillips Chemical Co. ..... 2nd Cover

Rockwell-Standard Corp., Brake Div. 34

Skinner Electric Valve Div., Skinner Chuck Co. 9
Sparta Mfg. Co. 12

U. S. Gasket Co., Special Products Dept. 19

Warner Electric Brake & Clutch Co. ..... 3rd Cover

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NEW LITERATURE

Reason and Chance in Scientific Discovery

R. TATON, Philosophical Library, 15 E 40th St, New York 16. 171 pp, 6 x 9½, $10.

The author is concerned solely with the problems of scientific creativity, as demonstrated in the history of mathematics and both theoretical and experimental work. Yet much of the analyses and conclusions quoted by Taton from the principal investigators, together with his own commentaries and opinion, should be of almost daily value to those engaged in employing scientific and engineering data in the development of products.

For example, the complex problems regularly met in modern industrial enterprises require engineering groups made up largely of specialists. Such specialists are likely to have different types of minds, hence different approaches to engineering situations. Poincare, the mathematician, is quoted in this book as saying, "It is the very nature of their minds which makes them either logicians or intuitionists . . ." On the other hand, Hadamard points out, ". . . many of those whose enunciation of their work and ideas would make them appear to be logicians, had to be intuitive to make their discoveries."

Obviously, where men differ in their approach to intellectual work, their motivations and reactions to objective conditions must also differ. As Taton makes abundantly clear, scientific history provides many illuminating examples of the relative significance of such factors as systematic analysis, intuitive flashes, chance, error, the struggle against routine and prejudice in the creative process of discovery.

Perhaps the final chapter, "Scientific Discovery As the Reflection of an Epoch," will seem the most immediately related to present-day research and development activities. Taton shows how frequently important discoveries have been the work of several men, working over long periods, sometimes with and other times without knowledge of each other's results. Taton concludes that collective effort, deliberately and contemporarily applied, is probably one of the primary characteristics of today's scientific activities. "The social, economic and technical reasons which have caused this development are so strong that it seems unlikely they will be arrested." Continuing, "While rational teamwork allows the systematic exploitation of some results . . . fundamental discoveries arise only from the original efforts of a scientist, free to follow any fruitful paths suggested by his intuition." —JK

Technical Information Groups

A symposium on the purposes, organization and techniques of groups devoted to securing, processing and retrieving data on technological developments took place at the Sept 7-12 meeting of the Div of Chemical Literature, ACS (1155 16th St NW, Washington 25, DC), in Chicago. The papers (Nos. 17 through 25 and, also, 35 and 36) discussed the need for information groups, functions, organization and staffing, economics, editing of abstracts, retrieval systems.

BERYLLIUM-COPPER TUBING – Memorandum 7, 6 pp. Describes mechanical and physical properties, applications, corrosion resistance, production limits, heat treatment, fabrication and standard tolerances of small-dia tubing. Superior Tube Co, 1556 Germantown Ave, Norristown, Penna.

Circle 1, Reader Service Card

METAL SPINNING—Brochure, 32 pp. Discusses production technique, advantages of the process, possible shapes, materials, tolerances, finishes and designing of parts. Curves indicate relationship of gage to finished dia. Metal Spinning Div, Phoenix Products Co, 4715 N 27th St, Milwaukee 9.

Circle 2, Reader Service Card

COMPUTATION CENTERS—Brochure CC-821, 16 pp. Describes scope, facilities and personnel of problem-solution service for engineering groups. Includes a step-by-step, problem-to-solution, picture-and-text-story of how service operates. Electronic Associates, Inc, Princeton Computation Center, PO Box 582, Princeton, NJ.

Circle 3, Reader Service Card

TRANSISTOR-EQUIPPED ELECTRONIC CIRCUITS—Brochure, 4 pp. Outlines several circuits of interest to engineer, student or hobbyist. Applications are described and illustrated. Motorola Semi-Conductors, 5005 E McDowell Rd, Phoenix, Ariz.

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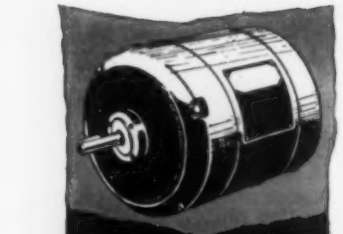

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Publisher's Postscript...

PLAN NOW for 1959

During the past 7 years US manufacturing facilities have expanded at a greater rate than in any other similar period in our history. Billions have been invested in new and enlarged plants. Some companies modernized clear through, others added the new but retained the old. So if you survey industry as a whole you will be shown much that is new and exciting, but if you dig in beneath the recent changes you'll find that a vast amount of out-of-date equipment is actually carrying the production load of today.

In Metalworking, for example, over half the production machinery in use is outdated. It's obsolete. This in spite of the vast array of new machines that produce more for less. Maybe we have been too busy producing—price levels have been high—but can we afford to go ahead much longer without first checking to see if new equipment won't put us in a stronger competitive position next month or next year?

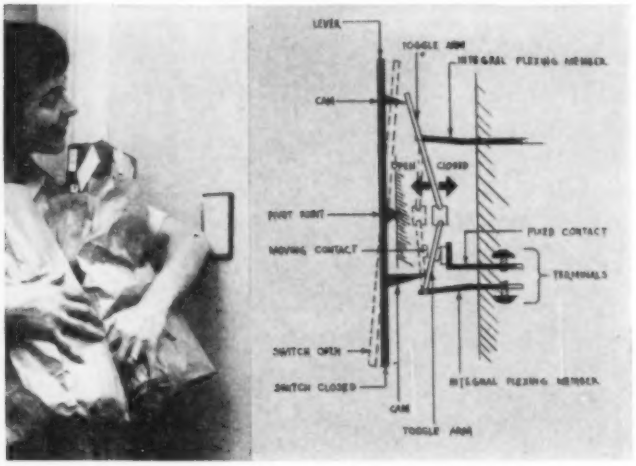
All this also applies to engineering departments. Many companies have built the most modern facilities—installed computer centers, modern drawing reproduction, handling and filing systems, effective library facilities, to say nothing of modern model shops, product-testing and development operations. Naturally every company doesn't need *all* these facilities, but it's amazing how many still roll along in exactly the same way they did a decade ago while their more progressive competitors slowly take over the market.

In this issue, the editors devote considerable space to point out why and where an engineering department should and can improve its facilities for better and more efficient operations. In the issue to follow they will explain how progressive companies have applied the new methods and techniques.

They call it PLAN 59. Plan now to be modern for 1959. This is a good time to take stock—to see how your facilities compare with the best of those of your competitors—to be fully prepared to handle the increased engineering load we all face for the future. This effort by the editors of PRODUCT ENGINEERING is being backed up by the editors of all McGraw-Hill publications. Each of 34 publications will present the results of months of field work and study, pointing up how the industries served by the various publications can profit by putting their facilities on a modern plane.

The total impact of this combined editorial effort will help persuade management that this is a good time to act. You can use these reports as a guide in the selection of new facilities essential to future growth. —A.H.

74 For Your Information (personal)



Switch Worked by Nudge

There is more than a dressy look to the "Fashion Plate" wall switch created by Bryant Electric. It's designed to operate at the touch of a finger or the nudge of an elbow—pressing one end of the wall plate turns the light ON; pressing the other returns it to OFF.

You've got to peek behind the plate to see the modified toggle joint and integral flexible members that transmit the pressure which opens or closes the contact. Pressure against the toggle is relayed to the silver contacts via knife-edge bearings on the outer end of each toggle arm. A nylon block serves as insulator for the toggle arms as well as center pivot for the toggle joint.

Bryant plans to make its Fashion Plate available commercially this year, in standard ratings, for mounting in standard wall boxes.

Handy Joiner

Baby welder, designed for the hobbyist, but probably headed for a good many model shops and R & D labs, is priced at less than $150. It has two welding current ranges, either ac or dc, a movable shunt for continuous current control, built-in "weld stabilizer" and semiconductor rectifiers. It takes 230-v, 37-amp current; is 17 in. high, about 20½ in. deep, weighs 137 lb, will take electrodes up to and including ⅛ in. dia. Air Reduction makes it, call it the Busybee.

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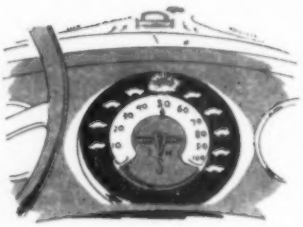
WHY DON'T THEY RESEARCH and DEVELOP...

. . . a refrigerator door which, when opened, either slides down or to the side, rather than swinging out into the room. One of the new flexible foams might be used. They are excellent insulators and could function like the old rolled-top desk, or as a corrugated curtain.

—B. W. Hausman



. . . a proximity warning system to remind the driver when he is following another car too closely. A simple radar, electromagnetic, or capacity pickup could be triggered when cars are separated by less than proper car lengths per mph, and flash a light or buzzer on the dashboard.

—V. G. Peck

. . . an inexpensive oxide-preventive coating for heat treatment of steels, thus eliminating the need for costly controlled atmosphere equipment. The coating should be sprayed, painted or taped on, and must be not only inert, colorless, heat- and flame-resistant, but also permit proper heating, quenching, optical pyrometer observation, and easy removal by chipping, machining or grinding.

—B. M. Robinson

. . . do-it-yourself hydraulic components? Low-cost cylinders and control valves made of noncorrosive materials could be operated by city water pressure (35 psi). Cylinders could do many jobs around the house—open garage doors, lift a TV set into view, open or close windows. Hose or light tubing to water supply and drain, a cylinder, and a 4-way valve would replace electric connections and expensive motors, gears, chains and the like.

—W. G. Sesko

Have you a pet subject but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer

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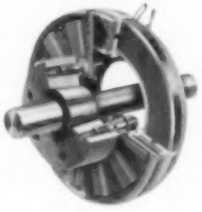
WARNER

electric motion control FACTS

for IDEA MEN

Electric brakes synchronize automatic paper pasting!



Modern, high-speed news presses don't stop when they come to the end of a paper roll. The paster pilot, located beneath the press, automatically splices on the start of a new roll and cuts off the remnant of the old one while the press is operating at speeds up to 60,000 papers per hour.

Warner electric brakes prevent rocking, automatically release when splice is made

Electric brakes are mounted on each roll spindle (Fig. 1) and prevent the rolls from rocking motion sometimes caused by imperfect balance of the newsprint. With positive braking and automatic release, it is no longer necessary to manually brake the rolls or stop the press while a splice is being made.

When the new roll is indexed into pasting position, the brush and web-severing carriage is lowered, the pre-drive takes over, and the pasting is completed "on the fly." The paster pilot conserves newsprint by "sensing" press speed and automatically presetting the time for the pasting cycle, thereby producing uniform cores with 3/16 in. or less of paper.

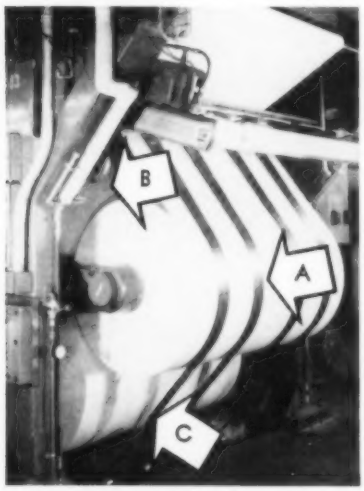


Fig. 1—Continuous printing is made possible by automatic paper splicing. Brush and web-severing carriage, directly above expiring roll (A), paste on the new roll (B), which then becomes the expiring roll. Loading roll (C) indexes into new roll position.

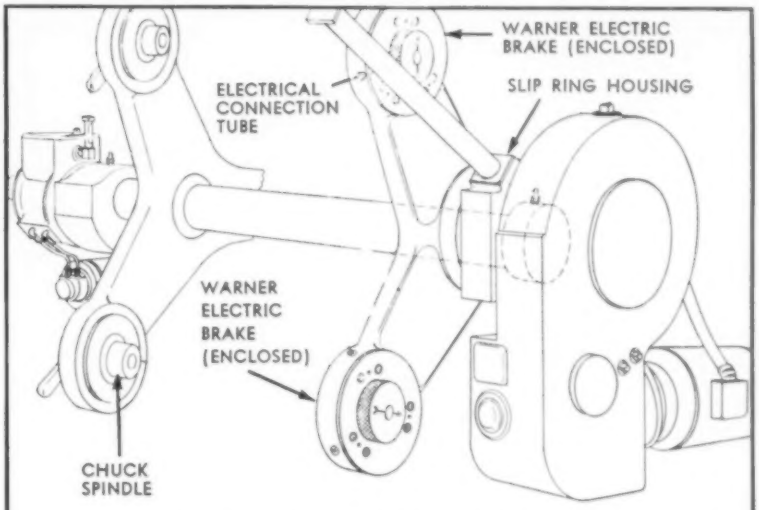
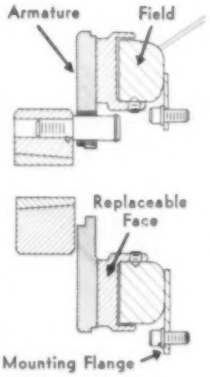


Fig. 2—Warner electric brakes are mounted on each roll spindle to prevent rocking and provide synchronized release at high speeds when splice has been completed.

Spacesaving design solves mounting problem



One of the design problems on this equipment was to fit the electric brakes into the compact, enclosed spindle indexing assemblies. Warner's compact armature-magnet design easily solved this problem. The electrical connections were made through the reel spider from a slip ring on the main reel spindle. Wiring was strung in from a stationary connecting tube (see Fig. 2) to the brushholder assembly.

New replaceable-face electric brakes

Many users of Warner electric brakes are switching over to our new replaceable-face design. In most cases, this change can be made without redesign of the product. Benefits to the customer include longer wear life and easier replacement of friction surfaces without disturbing electrical connections.

The "RF" brake (see sketch) consists of three basic elements, one rotating and two stationary. The field and replaceable face are assembled as one unit, which is flange-mounted to the machine. Properly installed, the field and its electrical connections never have to be disassembled or adjusted. The replaceable-face assembly fits *over* and *around* the field, and is affixed thereto by a number of easily accessible cone-pointed setscrews. The rotating member, or armature, is hub-mounted to the shaft and driven by pins which provide automatic wear adjustment. No other electric brake, no matter how similar to the Warner design, gives you the service and wear life features of the "RF" design.

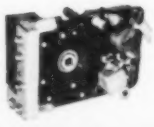
Want more IDEAS?

Send for factual application sheets showing how machines are made more productive, easier to control, simpler to maintain with electric brakes and clutches. Write to:

Industrial Products Division
Warner Electric Brake & Clutch Co.
Beloit, Wisconsin

WARNER **ELECTRIC BRAKES & CLUTCHES**

Hummingbirds Are Power-Packed...have more energy for their size than an elephant. Smallest hummingbird is only 2⅜" long, builds a nest only 1" square with cobwebs. The hummingbird is one of nature's greatest masterpieces in miniaturization.



Miniature Tape Recorder fits in briefcase . . . operates on hearing-aid batteries yielding 1/8000 h.p. This is possible because friction is reduced by two MPB bearings installed on the main drive shaft. Another man-miracle in the world of miniaturization.

Man With Miracles. This is Bill Timmerman, one of MPB's Sales Engineers. He helped the tape recorder people find exactly the right type of bearing to reduce friction to a minimum, give failure-proof service and help keep original and maintenance costs low.

More Miracles in Miniaturization to come

BEARING ACTUAL SIZE

It's just starting. Industry is on the threshold of new miracles in the world of miniature mechanisms. Best help in the problems will be MPB who has the world's greatest wealth of experience in the application of miniature bearings ⅜" O.D. or less. MPB has more than 500 types and sizes, specials on request, engineering and research facilities second to none. You'll want to know more about miniaturization and the promise of progress it holds. For engineering aid and/or new catalog write **Miniature Precision Bearings, Inc.,** 210 Precision Park, Keene, N. H.

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